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## THE DEHISCENCE OF MYCENASTRUM CORIUM

W. H. LONG

(WITH PLATE 13)

The Lycoperdales is a group of fungi to which the majority of "puffballs," "devil snuffboxes," etc., belong.

Their methods of dehiscence are many and more or less characteristic and constant for certain genera. The manner in which the peridia split is often made the basis for generic distinctions. In most of the puffballs there is a true dehiscence at maturity, while other species do not have a true dehiscence but depend upon the action of rains, winds, etc., to produce spore dispersion.

In a great majority of the geasters the peridia open when wet and close more or less when dry. There is one genus of the Lycoperdaceae, however, which reverses this process, expanding when dry and closing when wet. This puffball is *Mycenastrum corium*, a species which does not have a true dehiscence like a *Tylostoma* or a *Geaster*, but depends upon weathering for the splitting of its peridium, and the subsequent dispersion of its spores.

*Mycenastrum corium* is widely distributed throughout the world, having been found in many localities in both hemispheres. It is globular in shape, terrestrial in its habits, and is found throughout the southern United States growing on various types of soil. The writer has found it flourishing in sand, granite debris, black soil and clay, ranging from sea level to 8000 ft. elevation. In hot dry climates it grows in the immediate vicinity

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of trees and shrubs, but not close enough to be shaded throughout the entire day. The young plants are white externally, being covered with a soft cottony layer of mycelium. The peridium is very thick in the earlier stages, ranging from 2–4 mm. thick. The outer white layer is very thin and gradually peels off in weathering. The mature plant does not open in any definite manner, nor does it have any natural mouth. After the spores are ripe the globular fruit body remains attached to the soil for a long time.

The peridium of the mature plant is thick and leathery and remains for several months in an indehiscent condition. Then after alternate wettings and dryings fissures develop across the top (PLATE 13, FIG. 1). These fissures usually radiate from a common center near the apex of the fruit body and finally produce very irregular star-like teeth. In time the entire upper half of the puffball is open and exposed during dry weather (PLATE 13, FIG. 2). In this condition the spores are blown out by the wind and widely distributed. During every rainy spell this puffball promptly closes (PLATE 13, FIG. 3) only to open again when dry weather returns. At each alternate opening and closing the peridium is split more and more, until finally it is expanded into a flat or even recurved shape (PLATE 13, FIG. 4).

*Geaster hygrometricus* is a fine example of the usual type of dehiscence in which the peridia open when wet (PLATE 13, FIG. 5) and close when dry (PLATE 13, FIG. 6). This difference in method of dehiscence between *Mycenastrum corium* and *Geaster hygrometricus* is due to differences in the structure of the peridia of the two plants. In *Mycenastrum corium* the outer layer of the peridium is composed of cells so arranged that when wet they absorb water and expand, thus closing the top of the puffball. Then when drying these outer cells lose water and gradually shrink, thus producing an unequal tension between the outer and inner cells of the peridium. This causes the irregular star-like pieces of the peridium to gradually separate and curve outward, thus opening the top of the puffball during dry weather.

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FOREST PATHOLOGY,
ALBUQUERQUE, N. M.

DESCRIPTION OF PLATE 13

FIGS. 1–4. Photographs of *Mycenastrum corium*.

1. Development of fissures across the top of the peridium after alternate wetting and drying.

2. Upper half of peridium open during dry weather.

3. Manner of closing during rainy weather.

4. Final stage of expansion of peridium showing its open flat shape.

FIGS. 5–6. *Geaster hygrometricus*.

5. Open wet peridium.

6. Closed dry peridium.

All figures two thirds natural size.

# SPHACELOMA SYMPHORICARPI

ANNA E. JENKINS

(WITH PLATES 14 AND 15)

In critical comparisons of organisms of the polymorphic genus *Sphaceloma*, it is helpful to have at hand illustrations, particularly photomicrographs of their microscopic characteristics. These illustrations are available for a number of species, but, so far as the writer is aware, not for *S. Symphoricarpi* Barrus and Horsfall (**1**), causing the destructive anthracnose of snowberry (*Symphoricarpos albus* Blake, var. *laevigatus* (Fernald) Blake). There are here presented illustrations of the *Sphaceloma* named above, as it occurred in sections through lesions on leaves of snowberry gathered by the writer near Grantsville, Garrett County, Maryland, in August, 1928. The sections, however, were not made until June, 1929, but the organism may have been still viable. This seems the more probable as Scribner (**13**) noted viability for specimens of the raspberry *Sphaceloma*, of similar age. Not all of the characteristics of the snowberry *Sphaceloma* here depicted have been reported hitherto. Essentially all of them, however, have been discussed in one way or another for this or other closely related species, by various investigators.

The sections were made by means of the freezing microtome, but before sectioning the leaves were placed overnight on moist filter paper in a petri dish. Those here reproduced (PLATE 14 and PLATE 15) are unstained. PLATE 14, *F*, represents the entire thickness of the leaf; all the others show only the upper surface and underlying tissues.

## HISTORY AND DISTRIBUTION

The snowberry *Sphaceloma* appears to be fairly common and widespread in this country. It was first described by Barrus and Horsfall in 1928, at which time the only earlier report discovered by them was a brief note by Stewart (**14**) in which the

fungus was determined as *Gloeosporium* (?) sp. Barrus and Horsfall record the fungus from three counties in New York and from one county each in Arkansas, Iowa and Wisconsin. Its distribution as far west as Colorado has since been reported by Le Clerg (**9**). To this may be added one locality in the State of Maryland, as indicated above, and another county in New York. The last two records were based on observations of severely diseased snowberry clumps in more or less isolated situations.

Ordinarily the organism appears to infect the upper leaf surface and to fruit thereon rather than the lower. This condition is common to the avocado (*Persea* spp.) and rose (*Rosa*) species of *Sphaceloma* to which reference has previously been made (**5**, **8**). Davis (**3**) reports anthracnose lesions abundant on the fruit although acervuli are rare.

With respect to the control of the disease Barrus and Horsfall reported certain experiments undertaken by them in the endeavor to find a satisfactory treatment.

## DISCUSSION OF ILLUSTRATIONS

Hyphae, usually hyaline or deep reddish brown, and often rather coarse, are shown within or well beneath the epidermis (PLATE 14, *F*, *a*, and PLATE 15, *D* (arrow), *G*, *H*, *I* and *J*, *b*) as well as closely appressed to compact conidiophore pustules (PLATE 15, *A* and *B*). The two vertical hyphae, shown in PLATE 15, *D*, as extending upward from the oblique hyaline one within the palisade parenchyma, appear to be conidiophores. In most instances, however, the conidiophores have arisen perpendicularly from strands of hyphae extending horizontally through one or more cells of the epidermis (see PLATE 14, *A* and *F*, and PLATE 15, *J*, *b*, and other figures in the two plates) after the manner illustrated by the writer for the citrus *Sphaceloma* grown (**4**) in pure culture or developed (**6**) on its natural host. Seen in section, the acervuli, or sporodochia through their further development, are limited to one or a small number of contiguous epidermal cells, or may extend indefinitely for a considerable distance (see illustrations). The light colored *Stilbum*-like structure shown in PLATE 14, *E*, *a*, apparently corresponds to certain formations

reported by Osterwalder (**10**) for the *Sphaceloma* of apple and pear (see **8**). On the periphery of the one here illustrated there is visible a cap-like development which appears to be an outer covering of some of its exposed fungus cells (PLATE 14, *E*, *c*). Burrill (**2**), in discussing the raspberry *Sphaceloma* in 1882, stated that Dr. Thomas A. Taylor in an article in the "Small Fruit Recorder" had referred [1] this *Rubus* organism to the genus *Stilbum*. Such being the case, the author cited by Burrill may have observed growths like those here discussed. Similar ones have been seen by the writer (**6**, **7**) in *Sphaceloma* on *Citrus* and Lima bean.

Attached young conidia are shown in PLATE 15, *J*, *a*, while similar although larger germinated conidia are illustrated in PLATE 14, *A* (upper part of figure). Granting that the organism was still viable at the time of sectioning, all this development may have occurred during the time the material was in the moist chamber. In like manner, the germinated conidia of the *Rubus Sphaceloma* observed by Scribner in similar examinations of several-months-old herbarium specimens may have formed, as well as germinated, in his cultures of such material. Swollen *Coniothecium*-like conidia are present in PLATE 14, *D* (arrow), and PLATE 15, *H*. The object out of focus in PLATE 15, *I* (arrow), is a conidium on the surface of which sprout other conidia fully as large for instance as the three primary conidia in PLATE 14, *C*. These three conidia have apparently formed in succession from the hyaline vacuolate conidiophore beneath them. The septate structure shown in PLATE 15, *F*, appears to be a differentiated conidium, or a lengthened conidiophore, on the three points of whose apical cell conidia may have been produced.

In the sections minute spherical bodies were not uncommonly seen, often occurring in globular masses, then appearing as a hyaline or yellowish somewhat translucent glistening substance of granular consistency. Each granule appeared to consist of a bright refringent center or mere point surrounded by a thickened apparently mucilaginous substance or wall. All or most of these

[1] Although a search has been made for it the original statement has not been found.

bodies appeared to be microconidia of the organism. On the parts of sections here illustrated, and in some cases still visible as photographed, these microconidia were present in the following figures: PLATE 14, *A* (arrow) = PLATE 15, *E* (arrow), *B* (intermingled with free conidia in concavity between the two acervuli and on the surface of acervulus at right), *C* (intermingled with mass of free conidia at left of fructification), and PLATE 15, *J* (on surface of conidiophores below letter *a*). Granules of practically the same description as those discussed above produced in similar situations have been observed by Prillieux (**11**, p. 316; **12**, pp. 37–38), Viala (**15**, pp. 304–305, fig. 119), Viala and Pacottet (**16**, 1905, p. 663, and 1906, p. 89, fig. 22) and by the writer (**6**, **7**) for other species of *Sphaceloma* and another related genus.

Although not illustrated, conidia were present on the lower leaf surface, as well as within the leaf structure where they were apparently borne on hyphae permeating the tissues.

## SUMMARY

This account presents photomicrographs depicting the appearance of the anthracnose organism of snowberry, *Sphaceloma Symphoricarpi*, as represented by sections of snowberry leaves gathered at Grantsville, Maryland, August, 1928. The sectioning was not done until several months later, the leaves in the meantime having been dried and preserved as herbarium specimens. Several hours previous to sectioning the leaves were placed in a moist atmosphere. At the time of sectioning the *Sphaceloma* may have been still viable, as was definitely noted by Scribner for specimens of the raspberry *Sphaceloma* of similar age. Not all of the characteristics of the organism depicted have been reported hitherto, but essentially all of them had been observed and discussed in one way or another for closely related species.

BUREAU OF PLANT INDUSTRY,
U. S. DEPARTMENT OF AGRICULTURE,
WASHINGTON, D. C.

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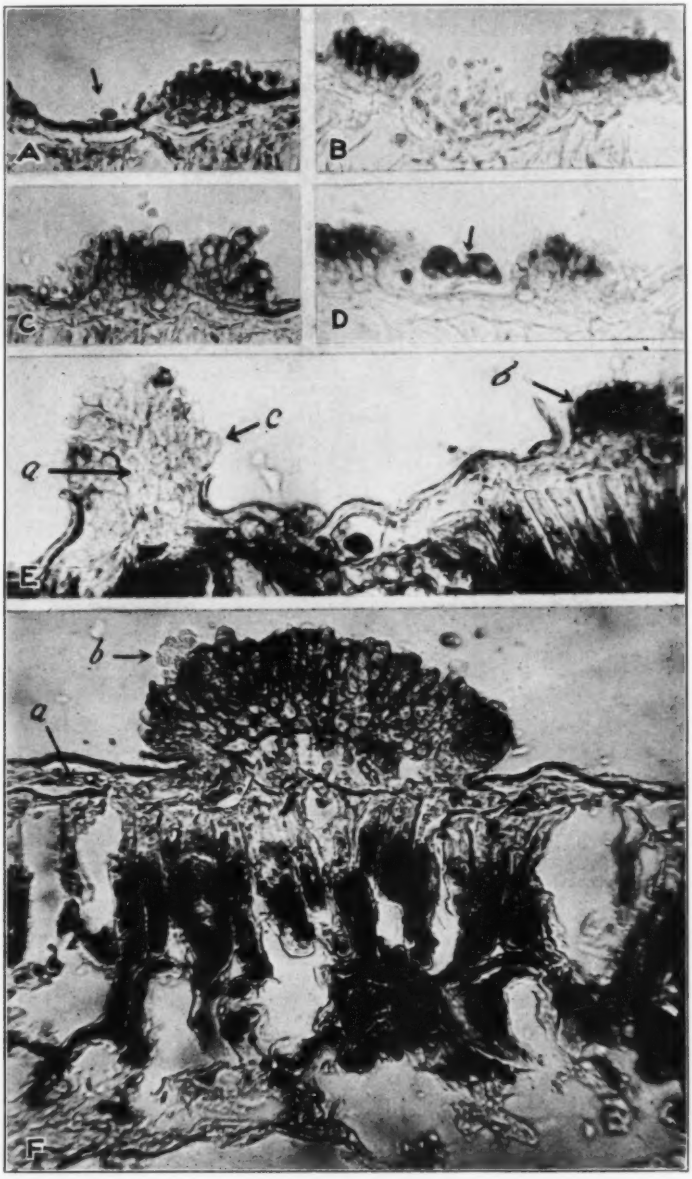
16. —— **& Pacottet, P.** Nouvelle recherches sur l'anthracnose. Rev. Vitic. **24**: 657–663; **25**: 89–91. 1905–1906. (Illus.)


## EXPLANATION OF PLATES

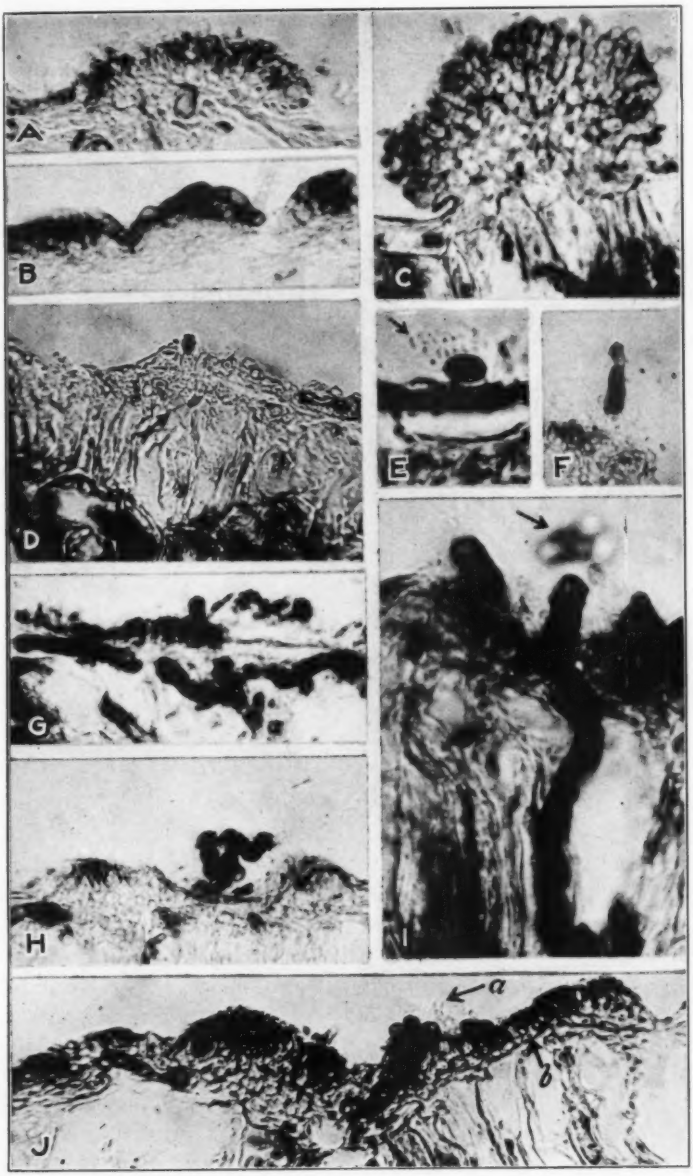
PLATE 14. *Sphaceloma Symphoricarpi*. Conidial fructifications and hyphae on leaves of snowberry, × 380.

PLATE 15. *Sphaceloma Symphoricarpi*. Additional fructifications and hyphae on leaves of snowberry, *E* and *I*, × 800, the others × 380.

(Photographs by Mr. J. F. Brewer.)




SPHACELOMA SYMPHORICARPI




SPHACELOMA SYMPHORICARPI

# FUNGI OF SANTO DOMINGO— III. UREDINALES [1]

F. D. KERN AND R. CIFERRI

The first paper in this series was contributed by Rafael A. Toro and published in MYCOLOGIA in 1927 (vol. 19, pp. 66–84). This paper dealt with collections of Phycomycetes, Ascomycetes, and Fungi Imperfecti, and reported 97 species. The second paper was by the senior author and appeared in MYCOLOGIA in 1928 (vol. 20, pp. 60–82). That paper reported 86 rusts of which 30 had been previously reported from Santo Domingo. It should be explained here that we have used the name Santo Domingo as synonymous with the Dominican Republic (Republica Dominicana, official) and not as co-extensive with the island Hispaniola, which includes also the Republic of Haiti (Republique d'Haiti).

The present paper is founded chiefly on collections made by the junior author during 1929. We are indebted to Dr. E. L. Ekman for several fine collections as well as for the determinations of the host plants and the reading of this manuscript. In the following list it is understood that Dr. R. Ciferri is the collector unless there is a notation to the contrary. The abbreviation "Est. Nac. Agr." refers to the Estacion Nacional Agronomica, which is located at Moca, province Espaillat.

Several species are here reported for the first time from Santo Domingo and several new hosts and localities are cited. Among the rusts now being first reported from this region the following are of especial interest: *Puccinia Helianthi-mollis*, *Puccinia Sarachae*, *Uromyces Medicaginis*, *Uromyces Salmeae*, *Endophyllum decoloratum*, and *Pucciniastrum Agrimoniae*.

1. PUCCINIASTRUM AGRIMONIAE (Schw.) Tranz. Scripta Bot. Hort. Univ. Petrop. **4**: 301. 1895.

On *Agrimonia parviflora* Sol., Valle del Yaque, prov. Azua, alt. 1500 m., Oct. 5, 1929, *Dr. E. L. Ekman 2601*.

[1] Read before the Mycological Section of the Botanical Society of America at the Des Moines meeting, December 30, 1929.

Although this rust is widely distributed in North America, and is known also from South America, Europe, and Asia, this is the first report of it from the West Indies.

2. PROSPODIUM TABEBUIAE Kern, Mycologia **20**: 63. 1928.

On *Tabebuia Berteri* (DC.) Britt., thickets on savanna near Los Alcarrizos, prov. Santo Domingo, alt. 200 m., May, 1929, *2567*.

This rust is evidently rare. The host of this specimen agrees so closely with that of the type specimen that we can conclude that the host of the type, which was listed as *Tabebuia* sp., is doubtless *T. Berteri*.

3. ENDOPHYLLUM DECOLORATUM (Schw.) Whet. & Olive, Am. Jour. Bot. **4**: 49. 1917.

On *Wedelia trilobata* (L.) Hitchc., Villa Vásquez, prov. Monte Cristi, June, 1929, *2583*.

This is the first report of this species from Santo Domingo.

4. ENDOPHYLLUM CIRCUMSCRIPTUM (Schw.) Whet. & Olive, Am. Jour. Bot. **4**: 49. 1917.

On *Cissus sicyoides* L., Esperanza, on the Mao road, prov. Santiago, June, 1929, *2569*; Pimentel, prov. Duarte, August, 1929, *2527*.

5. PUCCINIOSIRA PALLIDULA (Speg.) Lagerh. Tromsö Mus. Aarch. **16**: 122. 1894.

On *Triumfetta semitriloba* Jacq., Villa Vásquez, prov. Monte Cristi, July, 1929, *2561* (in part).

6. BOTRYORHIZA HIPPOCRATEAE Whet. & Olive, Am. Jour. Bot. **4**: 47. 1917.

On *Hippocratea volubilis* L., humid forest, near Bonao, prov. La Vega, alt. 400 m., June 22, 1928, *2564*.

7. RAVENELIA INDIGOFERAE Tranz. Hedwigia **33**: 369. 1894.

On *Indigofera tinctoria* L., Est. Nac. Agr., Moca, prov. Espaillat, alt. 140 m., July, 1929, *2554*.

8. UROMYCES BIDENTIS Lagerh. Bull. Soc. Myc. Fr. **11**: 213. 1895.

On *Bidens pilosa* L., Pimentel, prov. Duarte, August, 1929, *2525*.

This microcyclic species is known from Porto Rico, Costa Rica, and South America. This is the first report from Santo Domingo.

9. UROMYCES CESTRI (Mont.) Lév. Ann. Sci. Nat. III. **8**: 371. 1874.

On *Cestrum macrophyllum* Vent., humid forest, Diego de Ocampo, prov. Santiago, alt. 950 m., July, 1929, *2551*.

Not before reported from Santo Domingo.

10. UROMYCES COLUMBIANUS Mayor, Mem. Soc. Neuch. Sci. Nat. **5**: 467. 1913.

On *Melanthera Buchii* Urban, Agric. Exper. Station, Jaina, prov. Santo Domingo, March 4, 1927, *2579*.

This is apparently the first report on this species of host from North America. We have found the rust on three phanerogamic specimens of this host, one from Santo Domingo and two from Haiti as follows: Jarabacoa, prov. La Vega, Santo Domingo, June, 1912, *Padre Miguel Fuertes;* vicinity of Mission, Fondo Verettes, Haiti, Apr. 17–May 4, 1920, *E. C. Leonard 3614;* St. Michel de l'Atalaye, Dept. du Nord, Haiti, Dec. 5, 1925, *E. C. Leonard 7737*.

11. UROMYCES DOLICHOLI Arth. Bull. Torrey Club **33**: 27. 1906.

On *Cajan Cajan* (L.) Millsp. (*C. indicus* Spreng.), Est. Nac. Agr., Moca, prov. Espaillat, alt. 140 m., July, 1929, *2550*; Villa Vásquez, prov. Monte Cristi, July, 1929, *2560*.

12. UROMYCES MEDICAGINIS Pass.; Thüm. Herb. Myc. Oecon. *156*. 1874.

On *Medicago sativa* L. cult., Est. Nac. Agr., Moca, prov. Espaillat, alt. 140 m., March 8, 1928, II, III, *2568*; Villa Vásquez, prov. Monte Cristi, June, 1929, II, III, *2576*.

This rust on alfalfa is widely distributed in North America, is known also in Europe, India, and South America, but has been known previously from the West Indies only from Cuba.

13. UROMYCES PROËMINENS (DC.) Pass. Rab. Fungi Eu. *1795*. 1874.

On *Chamaesyce hirta* (L.) Millsp. (*Euphorbia pilulifera* L.), Est. Nac. Agr., Moca, prov. Espaillat, alt. 140 m., May, 1929, *2580*.

*Chamaesyce hypericifolia* (L.) Millsp. (*Euphorbia hypericifolia* L.), near Rincon road, prov. La Vega, July, 1929, *2572*; Est. Nac. Agr., Moca, prov. Espaillat, alt. 140 m., May, 1929, *2581*.

*Chamaesyce nutans* (Lag.) Small (*C. Preslii* Arth., *Euphorbia nutans* Lag.), Est. Nac. Agr., Moca, prov. Espaillat, alt. 140 m., May, 1929, *2573*.

14. UROMYCES SALMEAE Arth. & Holw. Am. Jour. Bot. **5**: 445. 1918.

On *Salmea scandens* (L.) DC., humid forest, Diego de Ocampo, prov. Santiago, alt. 950 m., July, 1929, O, I, *2586*.

The first report of this species outside of Porto Rico and Guatemala.

On a phanerogamic specimen of *S. scandens*, H. von Türckheim *3050*, collected in March, 1910, near Constanza, prov. La Vega, teliospores have been found.

15. PUCCINIA CANALICULATA (Schw.) Lagerh. Tromsö Mus. Aarch. **17**: 51. 1894.

On *Cyperus Haspan* L., in savanna near Pimentel, prov. Duarte, August, 1929, *2575*.

A new host for North America.

16. PUCCINIA CANNAE (Wint.) P. Henn. Hedwigia **41**: 105. 1902.

On *Canna coccinea* Ait., humid forest near La Vega, prov. La Vega, alt. 150 m., June, 1929, *2577*.

17. PUCCINIA HELIANTHI-MOLLIS (Schw.) Arth. Résult. Sci. Congr. Bot. Vienne 344. 1906.

*Puccinia Helianthi* Schw. Schr. Nat. Ges. Leipzig **1**: 73. 1822.

On *Helianthus annuus* L. cult., Est. Nac. Agr., Moca, prov. Espaillat, alt. 140 m., July, 1929.

This is the first report of the sunflower rust from Santo Domingo. It has heretofore been known in the West Indies only in Cuba. It is a common species in the United States, southern Canada, and Europe.

18. PUCCINIA HETEROSPORA Berk. & Curt. Jour. Linn. Soc. **10**: 356. 1868.

On *Sida urens* L., Diego de Ocampo, Santiago, alt. 900 m., July, 1929, *2559*; Villa Vásquez, prov. Monte Cristi, July, 1929, *2561*.

19. PUCCINIA LEONOTIDIS (P. Henn.) Arth. Mycologia **7**: 245. 1915.

*Puccinia dominicana* Frag. & Cif. Bol. R. Soc. Esp. Hist. Nat. **26**: 248. 1926.

On *Leonotis nepetaefolia* (L.) R. Br., Est. Nac. Agr., Moca, prov. Espaillat, alt. 140 m., June, 1929, *2584*; Santo Domingo City, prov. Santo Domingo, Dec. 15, 1929, *Dr. E. L. Ekman 2828*.

20. PUCCINIA MALVACEARUM Bert. Mont. in C. Gay, Fl. Chil. **8**: 43. 1852.

On *Malvastrum coromandelianum* (L.) Garcke, Est. Nac. Agr., Moca, on the road to Jamao, prov. Espaillat, alt. 140 m., June, 1929, *2574*.

*Malvastrum spicatum* (L.) A. Gray, Est. Nac. Agr., Moca, prov. Espaillat, alt. 140 m., June, 1929, *2582*.

The latter is a new host for North America.

21. PUCCINIA POROPHYLLI P. Henn. Hedwigia Beibl. **39**: 153. 1900.

On *Porophylium ellipticum* Cass., Est. Nac. Agr., Moca, prov. Espaillat, alt. 140 m., June, 1929, *2571*.

This is an extension of the distribution of a species previously known from southern Mexico and northern South America.

22. PUCCINIA SARACHAE Mayor, Mem. Soc. Neuch. Sci. Nat. **5**: 499. 1913.

On *Saracha antillarum* Krug & Urban, Valle Nuevo, prov. La Vega, alt. 2500 m., Oct. 16, 1929, *Dr. E. L. Ekman 2617*.

The first report from Santo Domingo of a South American species which is known also in Costa Rica and Jamaica.

23. PUCCINIA URBANIANA P. Henn. Hedwigia **37**: 278. 1898.

On *Cornutia pyramidata* L., Los Alcarrizos road, prov. Santo Domingo, June, 1929, *2565*; banks of Rio Ozama, prov. Santo Domingo, Dec. 15, 1929, *Dr. E. L. Ekman 2830*.

24. PUCCINIA VERSICOLOR Diet. & Holw. Bot. Gaz. **24**: 28. 1897.

On *Heteropogon contortus* (L.) Beauv., Monción, prov. Monte Cristi, alt. 475 m., June, 1929, *2558*.

This is another extension of distribution of a rust originally described from southern Mexico and since reported from Hawaii.

25. PUCCINIA XANTHII Schw. Schr. Nat. Ges. Leipzig **1**: 73. 1822.

On *Xanthium chinense* Mill. (*X. echinatum* of Urban, not Murr.), Pimentel, prov. Duarte, August, 1929, *2526*; humid forest, Diego de Ocampo, prov. Santiago, alt. 650 m., July, 1929, *2557*; Esperanza, on the Mao road, prov. Santiago, July, 1929, *2570*.

26. AECIDIUM ABSCEDENS Arth. Mycologia **7**: 315. 1915.

On *Randia aculeata* L., banks of Rio Ozama, prov. Santo Domingo, Dec. 14, 1929, *Dr. E. L. Ekman 2765*.

A new rust for Santo Domingo where it is apparently rare. This species has been known previously from Porto Rico, Costa Rica, and southern Mexico.

27. **Aecidium domingensis** sp. nov.

0. Pycnia chiefly hypophyllous, in small orbicular groups, punctiform, globoid or ovate, 150–175 $\mu$ in diameter.

1. Aecia chiefly hypophyllous, in orbicular groups 2–4 mm. across. Surrounding the pycnia, bullate, roundish, 0.3–0.4 mm. across, long covered by the overarching epidermis; aeciospores ovoid, sometimes pyriform, often angular and narrowed both above and below, 24–31 by 42–52 $\mu$, the wall 1.5–2 $\mu$ thick, somewhat thicker above, 3–4 $\mu$, colorless, sparsely echinulate-verrucose.

On *Baccharis myrsinites* (Lam.) Pers., Diego de Ocampo, prov. Santiago, alt. 1250 m., August, 1929, *R. Ciferri 2524*.

The form here described does not agree with any of the several species described on *Baccharis*. It is similar to *Puccinia evadens* in having large colorless spores with wall thicker above, but differs in the thickness of the walls and surface markings as well as in the gross characters of the sori and their distribution.

28. AECIDIUM TOURNEFORTIAE P. Henn. Hedwigia **35**: 253. 1896.

On *Tournefortia hirsutissima* L., Est. Nac. Agr., Moca, prov. Espaillat, alt. 140 m., May, 1929, *2563*.

29. UREDO BULLULA Kern, Mycologia **20**: 77. 1928.

On *Eupatorium odoratum* L., near Colonia Jamao, Moca, prov. Espaillat, alt. 700 m., July, 1929, *2566*.

30. UREDO TOROIANA Kern, Mycologia **20**: 76. 1928.

On *Vernonia cinerea* (L.) Less., Est. Nac. Agr., Moca, prov. Espaillat, alt. 140 m., July 4, 1929, *2562*.

In addition to this collection this rust has been found on a phanerogamic specimen of *Vernonia cinerea* collected by *E. C. Leonard*, no. *7452*, at St. Michel de l'Atalaye, Dept. du Nord, Haiti, making four widely separated stations on the island.

THE PENNSYLVANIA STATE COLLEGE,
STATE COLLEGE, PA.
ESTACION NACIONAL AGRONOMICA,
REPUBLICA DOMINICANA.

# THE NON-SEXUAL STAGE OF APHANOMYCES PHYCOPHILUS

F. K. Sparrow, Jr.

(With 1 Text Figure)

Although it has been nearly seventy years since de Bary described the first algae-parasitizing species of *Aphanomyces*, *A. phycophilus* (1), little has been added to our knowledge concerning the habits and distribution of these interesting forms. It was a matter of some surprise to the writer, upon reading the extant papers concerning the aforementioned species, to find that, while the sexual stage of this fungus has been observed in several instances since de Bary's time, in no case had the discharged sporangia been seen. During the past summer while investigating the parasites of algae found in the vicinity of Cold Spring Harbor, L. I., the writer was fortunate in finding not only numerous oöspores of this species, but several discharged sporangia as well. Because of the apparent rarity of the non-sexual stage of this fungus and for the reason that in the Saprolegniaceae, to which *Aphanomyces* belongs, it is of considerable taxonomic significance, the preparation of this brief note has seemed advisable. Furthermore, from a careful reading of de Bary's original description it is evident that he himself never observed the sporangia in the condition necessary for the complete identification of his fungus.

The fungus was found near the laboratory of the Long Island Biological Association, parasitic in an internodal cell of *Nitella* sp. (?), a host hitherto unreported as being attacked by any species of *Aphanomyces*. Attention was immediately directed to the fungus because of its conspicuous golden oöspores, the oögonial walls of which were similarly colored and covered with spine-like protuberances of varying length. Further investigation revealed the stout hyphal threads ramifying throughout the cell and several extramatrical sporangia. Each of the latter structures possessed an apical cluster of cystospores from which

practically all of the zoöspores had emerged. A careful examination of these sporangia showed them unquestionably to have originated from the same mycelium which bore the aforementioned oöspores.

The sporangium of *Aphanomyces phycophilus* is similar to that found in other species of the genus and, from the standpoint of its morphology, presents no particular features (TEXT FIG. 1*a*). It is simply a slender lateral branch of the mycelium which has penetrated, with no noticeable constriction of its diameter, the host cell wall, and which has extended for a varying distance out into the water. The diameter of this structure, although tapering slightly at its apex, is around 3.4 $\mu$. Actual discharge of the zoöspores from the evacuation tube and their characteristic emergence after a period of quiescence from the cystospores were not observed. It is presumed, however, that these processes occurred as in other species of *Aphanomyces*. The number of cystospores formed at the mouth of the evacuation tube was not numerous, seven being the maximum observed in the writer's material. These were 9.6 $\mu$ in diameter.

Save for emphasizing the golden color of the mature oöspore, the present writer can add nothing of importance to the descriptions of de Bary (**1**) and Weatherwax (**6**) of this structure (TEXT FIG. 1*b*). It should be noted, however, that the diameters of the oögonia found in *Nitella* were on the whole somewhat smaller than those given for this species (26–38 $\mu$ as compared with 40–50 $\mu$). In this, they more nearly approach the size (26 $\mu$) attained by the form found by Weatherwax.

De Bary first described this species from Germany in 1860 (**1**), where he found it parasitic in *Spirogyra lubrica* Kütz and *S. nitida* Kütz. The fungus was again reported in 1914 from Indiana by Weatherwax (**6**) as a parasite of *Spirogyra dubia* Kütz. The following year it was recorded from Michigan by Kauffman (**3**) and from Germany by von Minden (**4**), parasitizing in both instances species of *Spirogyra*. It might be noted at this time that the writer has examined material of this fungus collected in 1893 at York, Maine, by Dr. Roland Thaxter.[1]

[1] The writer wishes to thank Professor Thaxter at this time for his kindness in allowing him to examine not only this material but that of a number of other Phycomycetes.

As in the preceding instances, the fungus was found by him parasitic in *Spirogyra*.

Thus far but three other species of *Aphanomyces* have been described as parasites of algae. *A. norvegicus* Wille, differing from *A. phycophilus* in the dark brown color of its oöspore and oögonial walls, has been described by Wille (**7**) as a parasite of

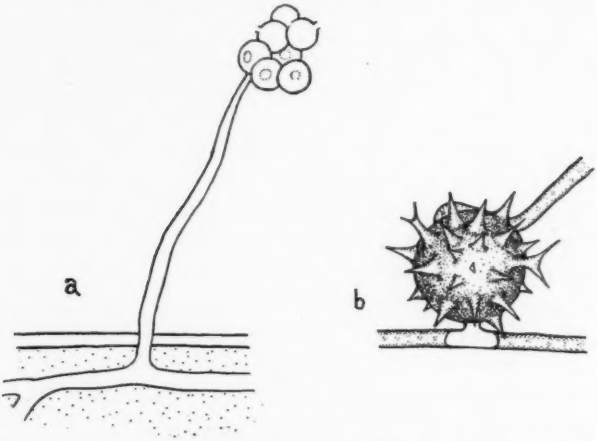



FIG. 1. (*a*) Discharged sporangium of *A. phycophilus* with apical cluster of empty cystospores, protruding from an infected cell of *Nitella* sp. (?). Content of the host cell is not shown but was normal. (*b*) Surface view of oogonium of fungus showing characteristic projections and a portion of the antheridium. Drawings were made from living material with the aid of the camera lucida. Approximately × 225.

*Zygnema*, *Spirogyra*, and *Mougeotia* in Norway. A form considered to be *A. laevis* de Bary by Coker (**2**) has been found by him as a parasite of diatoms and desmids in North Carolina. Recently, Skvortzow (**5**) has described from Manchuria a parasite of *Vaucheria sessilis* (Vauch.) DeCandolle and *V. uncinata* Kütz, termed by him *Aphanomyces Gordejevi* n. sp. There is reason to doubt, however, that this species really belongs to *Aphanomyces*, as only discharged sporangia were observed and these did not show evidences of the apical clusters of cystospores, nor were the meagre descriptions and poor drawings of the mature sex organs convincingly saprolegniaceous. On the con-

trary, the antheridia strongly resemble those formed by certain species of *Pythium*. Further, in no case was a *mature* oöspore figured.

Although the non-sexual stage of *A. phycophilus* is apparently recorded for the first time in this paper, there is little reason to believe it to be of rare occurrence, and it is hoped that further investigation by others interested in this group of organisms will yield a more thorough account.

THE BIOLOGICAL LABORATORY,
LONG ISLAND BIOLOGICAL ASSOCIATION,
COLD SPRING HARBOR, L. I.

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# PHOTOGRAPHS AND DESCRIPTIONS OF CUP-FUNGI—XI. SOLENOPEZIA [1]

FRED J. SEAVER

(WITH PLATE 16)

The above named genus was founded by Saccardo on *Peziza Solenia* described by C. H. Peck in 1873. In working over material in the herbarium of The New York Botanical Garden, the writer encountered an excellent specimen which is apparently a part of the type collection.

Since this was made the type of a genus and so little is known of it, the writer is taking this opportunity to describe the plant more in detail and supply illustrations. This is done with the hope of focusing attention on the fungus and possibly bringing in more material for study. It would seem very strange if other collections had not been made. The apothecia are so minute that it is impossible to get satisfactory photographs and it will be necessary to rely on drawings.

The apothecia are small and the mouths so constricted that they might easily be mistaken for the perithecia of a *Nectria*. However, when moist, the mouth does gradually expand although the hymenium never becomes conspicuously exposed. The species is characterized by two types of hairs on the outside of the apothecium, hyaline-tipped hairs about the mouth giving rise to a white border and dark-brown hairs below and covering the remainder of the apothecium.

A second species, *Solenopezia vulpina* (Cooke) Sacc., was included in the genus by Saccardo. This was originally described by Cooke as a *Peziza* but, as pointed out by the writer (Bull. Torrey Club **36**: 203. 1909), this is a synonym of *Nectria Peziza*, and should be excluded from the genus *Solenopezia*.

Later two additional species were referred to the genus:

[1] This paper is preliminary to a monograph of North American Cup-fungi (Inoperculates), a companion volume to North American Cup-fungi (Operculates) which was published by the author and issued in December, 1928.

*Solenopezia Symphoricarpi* Ellis & Ev. (Jour. Myc. **9**: 165. 1903) and *Solenopezia fimbriata* Ellis & Barth. (Jour. Myc. **8**: 174. 1902). Neither species has been seen and no statement can be made regarding them at the present time.[2]

The writer would be glad to receive any material which seems to belong to this genus for study in connection with his monograph of the North American Cup-fungi. The following is the diagnosis of the genus and type species.

SOLENOPEZIA Sacc. Syll. Fung. **8**: 477. 1889.

Apothecia sessile, minute, urceolate or rarely hemispherical, brown or light colored, externally clothed with hairs; asci typically 8-spored; spores ovoid, ellipsoid, or subfusoid, 1-septate, hyaline.

Type species: *Peziza Solenia* Peck.

SOLENOPEZIA SOLENIA (Peck) Sacc. Syll. Fung. **8**: 477. 1889.

*Peziza Solenia* Peck, Ann. Rep. N. Y. State Mus. **25**: 99. 1873.

Apothecia gregarious, sessile, minute, not exceeding .3 mm. in diameter, short cylindric, a little longer than broad, constricted at the mouth, externally clothed with brown hairs but with a white margin around mouth; hymenium not much exposed; hairs consisting of two kinds, those about the sides of the apothecium dark-brown, clavate, septate, slightly roughened and knotted, reaching a diameter of 5–6 $\mu$ and a length of 60–80 $\mu$, the marginal hairs similar in size and form but hyaline tipped and covered with minute granules; asci clavate, reaching a length of 65 $\mu$ and a diameter of 10 $\mu$; spores 2-seriate, fusoid, hyaline, becoming 1-septate, usually with 4 small oil-drops, about 3–4 $\times$ 12–13 $\mu$; paraphyses filiform, slightly enlarged above.

On dead stems of *Eupatorium ageratoides*.

*Type locality:* Watkins Glen, New York.

*Distribution:* Known only from the type locality.

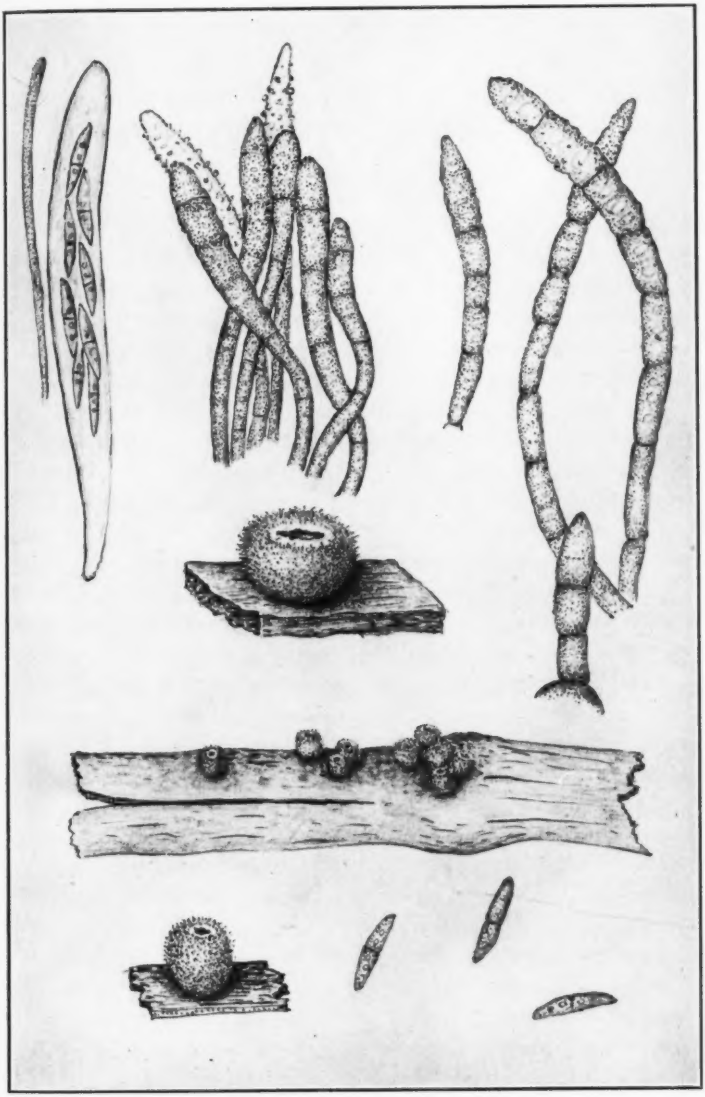
The above description and accompanying illustration were drawn from material in the herbarium of The New York Botanical Garden which is apparently part of the type collection.

THE NEW YORK BOTANICAL GARDEN

[2] Since the writing of this article type material of *Solenopezia fimbriata* loaned the writer by Dr. Elam Bartholomew of Hays, Kansas, shows it to be one of the Phacidiaceae and apparently a *Diplonaevia*. It is close to *Diplonaevia melaleuca* Ellis & Ev.

EXPLANATION OF PLATE 16

Drawing of a cluster of apothecia several times enlarged and two isolated apothecia greatly magnified. Also drawings of asci with spores and paraphysis and hairs from the outside of the apothecium. Cluster near the center showing the two kinds, the hyaline tipped and the brown. Asci spores and hairs drawn with the aid of the camera lucida.



SOLENOPEZIA SOLENIA

# MONOGRAPHIC STUDIES ON THE USTILAGINALES ATTACKING ANDROPOGON [1]

GEORGE LORENZO INGRAM ZUNDEL

While pursuing general studies on the Ustilaginales, it was found that fifty-nine species attack the genus *Andropogon*. At the suggestion of Dr. George Perkins Clinton, monographic studies of these species were made, under his direction, in the Osborn Botanical Laboratory, Yale University, and the botanical laboratory of the Connecticut Agricultural Experiment Station during 1927–1928. Specimens in the Clinton herbarium together with the personal specimens of the writer comprised most of the available working material. It was, however, necessary to secure the loan of type specimens of certain species from the Royal Botanic Gardens, Kew; the Jardin Botanique de l'Etat, Bruxelles; the Museum d'Histoire Naturelle, Paris; the Botanischer Garten und Museum, Berlin-Dahlem, for which acknowledgment and thanks is here given. It was further necessary to secure specimens of other species from the Department of Agriculture, Malta; the Bureau of Science, Manila, Philippine Islands, and from Dr. Rene Maire of Algiers, for which acknowledgment and thanks is given. Through the coöperation of all available agencies it has been made possible for the writer to personally examine spores of all but two species included in these studies, viz., *Sorosporium dembianense* Bacc. and *Sorosporium Heteropogon-contorti* Bacc. The description included in these studies of these two species is, therefore, based on the original description without a personal study of material.

Studies of material from the Agricultural Department of the Union of South Africa and other sources have given eighteen new species for which the following names are proposed: *Sorosporium Flanaganianum; Sorosporium proliferatum; Sorosporium*

[1] Contribution from the Osborn Botanical Laboratory, Yale University, and part three of a dissertation presented to the graduate school in partial fulfillment of the degree of doctor of philosophy, June, 1929.

*Clintonii; Sorosporium austro-africanum; Sorosporium harrismithense; Sorosporium Healdii; Sorosporium Hodsonii; Sorosporium pretoriense; Sphacelotheca Ritchiei; Sphacelotheca Doidgeae; Sphacelotheca Holwayi* Clinton & Zundel; *Sphacelotheca Evansii; Sphacelotheca concentrica; Sphacelotheca Kellermanii* Clinton & Zundel; *Sphacelotheca Moggii; Sphacelotheca Natalii; Sphacelotheca Transvaalii; Sphacelotheca Zilligii.*

In this paper there are seventy-six species of Ustilaginales reported as occurring on the genus *Andropogon* as follows:

| | |
|---|---|
| *Cintractia* | 1 species |
| *Sorosporium* | 28 species |
| *Sphacelotheca* | 39 species |
| *Tolyposporella* | 3 species |
| *Ustilago* | 5 species |

The following two species have been excluded from the Ustilaginales:

*Thecaphora Berkeleyana* Fisch. On *Andropogon perforatus*. This fungus upon microscopic examination proved to be close to *Cerebella Andropogonis* or *Epicoccum* sp.

*Tolyposporium philippinense* H. & P. Sydow. This is an *Epicoccum*-like saprophyte.

In the descriptions of the new species U. D. Agr. equals Herbarium of the Department of Agriculture, Union of South Africa.

The genus *Andropogon* as used in these studies is as defined by Engler in "Die Natürlichen Pflanzenfamilien." This genus generally prefers dry plains, savannahs, etc., in both the northern and southern hemispheres.

USTILAGO (Pers.) Roussel, Fl. Calvados, ed. 2. 47. 1806.

Spores 3–8 μ diameter.
- Sori destroying inflorescence ..... *U. amadelpha*
- Sori forming on the surface of sheath and leaves as striae or granular masses.
  - Spores 3–6 μ diameter ..... *U. effusa*
  - Spores 5–8 μ diameter ..... *U. occulta*

Spores 5–12 μ diameter.
- Sori attacking ovaries.
  - Spores echinulate ..... *U. Andropogonis-finitimi*
- Sori transforming floral stem into long, curved leafless outgrowth.
  - Spores smooth ..... *U. consimilis*

1. USTILAGO AMADELPHA H. & P. Sydow & Butler, Ann. Myc. **10**: 249. 1912.

Sori up to 8 cm. long, involving and destroying the entire inflorescence, at first hidden by the terminal sheath, surrounded by host tissue which breaks up into long, more or less curled, silvery shreds, revealing a dark brown mass of spores; spores reddish brown, globose-subglobose, rarely elliptical, very obscurely but abundantly echinulate under the oil immersion lens, 5–8 $\mu$ diameter.

On *Andropogon* sp.: India.

2. USTILAGO EFFUSA H. & P. Sydow, Ann. Myc. **4**: 425. 1906.

Sori forming on the inner surfaces of the sheath and of the leaves as long striae which fuse, forming a dense mass of dark brown spores; spores light olive brown, globose-subglobose, minutely verruculose under oil immersion, 3–6 $\mu$ diameter.

On *Andropogon squarrosus* (*A. muricatus*): India. *Andropogon Wallichii:* India.

3. USTILAGO OCCULTA P. Henn. Hedwigia **36**: 212. 1897.

Sori on the culms and inner parts of sheaths and leaves forming a black granular mass of spores; spores globose-subglobose, sometimes oblong, dark brown to almost black, minutely and abundantly verruculose, especially under the oil immersion, 5–8 $\mu$ diameter.

On *Andropogon* sp.: Brazil.

4. USTILAGO ANDROPOGONIS-FINITIMI Maub. Bull. Soc. Myc. (France) **22**: 74–75. 1906.

Sori in the ovaries, long linear, 5–7 mm. long, covered with a membrane of host tissue; spore mass brown, agglutinated, surrounding a well developed columella; spores dark reddish brown, globose-subglobose, semi-opaque, under oil immersion very abundantly echinulate, 9–12 $\mu$ diameter.

On *Andropogon finitimus:* Portuguese East Africa.

5. USTILAGO CONSIMILIS H. Sydow,[2] Ann. Myc. **22**: 281. 1924.

Sori transforming the floral stem into a long, curved, leafless stem-like outgrowth covered by a thin covering of host tissue;

[2] In 1924, H. Sydow found that *Ustilago Sacchari*, which was described by Rabenhorst in 1871 on *Erianthus Ravennae*, was not the smut that occurred on sugar cane. The sugar cane smut was, therefore, named *Ustilago consimilis*.

the lower part of the sori concealed by the sheath; spores reddish brown, globose-subglobose, smooth, 5–12 μ diameter; groups of hyaline thin-walled cells scattered throughout the sori.

On *Andropogon Sorghum* (*Saccharum vulgare*): Italy; Philippine Islands. *Saccharum cylindricum* (*Imperata arundinaceae*): Union of South Africa (Natal). *Saccharum erianthoides* (*Erianthus saccharoides*): Union of South Africa (Natal). *Saccharum fuscum:* India. *Saccharum officinarum:* Union of South Africa (Natal); India; Japan; Philippine Islands. *Saccharum spontaneum:* Philippine Islands.

CINTRACTIA Cornu, Ann. Sci. Nat. VI. **15**: 279. 1883

1. **Cintractia Vanderystii** (P. Henn.) Zundel, n. comb.

*Ustilago Vanderystii* P. Henn. Ann. Mus. du Congo V. **2**: 86. 1907.

Sori in the ovary, destroying the inflorescence; spore masses agglutinated around a central columella, dark brown; spores dark reddish brown, usually globose-subglobose, somewhat angular, smooth, 6–10 μ diameter.

On *Andropogon* sp.: Congo.

SPHACELOTHECA de Bary, Verg. Morph. Biol. Pilze 187. 1884

Sori involving the ovaries.
- Sori 1 cm. or less in length.
  - Spores 3–8 μ diameter.
    - Sori long linear.
      - Spores 4–6 μ, light olive to nearly hyaline ..... *S. Moggii*
      - Spores 5–7 μ, dark reddish brown *S. furcata*
      - Spores 6–10 μ, olive brown ..... *S. Doidgeae*
    - Sori not long linear.
      - Spores 4–6 μ ..... *S. sorghicola*
      - Spores 5–9 μ.
        - With groups of large sterile cells ..... *S. cruenta*
        - With chains of small globose cells ..... *S. Sorghi*
  - Spores 8–9 μ diameter.
    - Sterile tissue with evanescent cells ... *S. Andropogonis-annulati*
    - Sterile tissue with non-evanescent cells *S. Evansii*
  - Spores 9–12 μ diameter.
    - Sterile cells single, 11–16 μ diameter. *S. Nyassae*
    - Sterile cells in groups or chains, 7–12 μ diameter ..... *S. barcinonensis*

- Sterile cells in groups or chains, angular, 7–15 μ diameter ..... *S. Duthiei*
- Sterile cells usually in pairs, about 15 μ diameter ..... *S. tonkinensis*
- Spores 11–16 μ diameter.
  - Spores subglobose, often angled ..... *S. occidentalis*

Sori 1–5 cm. long and over.

- Spores 3–8 μ diameter.
  - Sterile cells rectangular, in chains, spores vacuolate ..... *S. Milbraedii*
- Spores 8–16 μ diameter.
  - Spores smooth.
    - Spores small, 7–12 μ diameter ... *S. Seymouriana*
    - Spores large, 11–14 μ diameter .. *S. guaranitica*
  - Spores echinulate or verruculose.
    - Spores thick-walled.
      - Sterile cells collapsed, in rows *S. Stuhlmanii*
      - Sterile cells not collapsed ... *S. Schoenanthi*
    - Spores thin-walled.
      - Spores reddish brown ..... *S. monilifera*
      - Spores olive brown ..... *S. Warneckiana*

Sori involving the entire inflorescence.

Sori 1 cm. or less.

- Spores 5–10 μ diameter.
  - Sterile cells rectangular, spores light reddish brown ..... *S. Nardi*
  - Sterile cells evanescent ..... *S. tenuis*
  - Sterile cells globose, large.
    - Spores smooth, banded ..... *S. concentrica*
    - Spores minutely echinulate ..... *S. Ritchiei*
- Spores 10–16 μ diameter.
  - Columella simple.
    - Spores dark reddish brown ..... *S. superflua*
    - Spores light reddish brown ..... *S. natalensis*
  - Columella branched, rootlike ..... *S. transvaalensis*

Sori 1–5 cm. long.

- Spores 5–12 μ diameter.
  - Spores vacuolated ..... *S. columellifera*
  - Spores verruculose.
    - Spores 5–8 μ, rarely 10 μ ..... *S. congensis*
    - Spores 7–12 μ ..... *S. bicornis*
  - Spores smooth.
    - Spores thick-walled, often angled *S. Dinteri*
    - Spores regular, globose.
      - False membrane light colored *S. Lanigeri*
      - False membrane brown ..... *S. Andropogonis*
    - Spores echinulate, 7–10 μ ..... *S. Zilligii*
- Spores 10–16 μ diameter.
  - Spores elongated with evident granular verruculations ..... *S. Kellermanii*

Spores less elongated with less evident granular verruculations ..... *S. Holwayi*
Spores 13–21 μ and over..... *S. culmiperda*
Sori 5–9 cm. and over.
Sterile cells rectangular, in chains, tinted brown..... *S. leucostachys*
Sterile cells globose, in groups, hyaline... *S. Andropogonis-hirtifolii*

1. **Sphacelotheca Moggii** Zundel, n. sp.

Sori in the inflorescence, long linear, 5–10 mm. long, single or in groups attacking individual flowers, usually hidden at first by the outer leaf sheath, often protruding later, covered with a sterile tissue which flakes away revealing a dark brown agglutinated spore mass surrounding a well developed, often forked, columella.

Sterile tissue very fragile and "tissue like," somewhat effervescent and adhering more or less to the outside of the sori, breaking up into groups or balls of sterile cells, which are tinted brown, vacuolated with granular contents, 7–12 μ diameter; the sterile cell spore balls, with 4 or more spores, 15–22 μ in diameter, globose-subglobose; balls of sterile cells are also scattered throughout the sorus.

Spores tinted olive brown to almost hyaline, vacuolated, globose-subglobose, regular, ranging from 4–6 μ diameter, smooth under oil immersion.

On *Andropogon plurinodis* (*Cymbopogon plurinodis*): Armoeds Vlatte, British Bechuanaland, Union of South Africa, coll. A. O. D. Mogg, August 28, 1924 (U. D. Agr. Myc. Herb. *19859*).

This species is closely related to *S. cruenta* in having the large globose balls of sterile cells but differs in the size of the sorus, in the texture of the outer false membrane, and in the color of the spores. May be parent of *S. cruenta*.

2. SPHACELOTHECA FURCATA Pat. & Hariot, in litt.

*Ustilago furcata* Pat. & Hariot, Jour. Bot. (France) **14**: 230. 1900.

Sori entirely destroying the ovaries, partially concealed by the glumes but elongated, 8–12 mm., and later protruding between the glumes. Covered by a false membrane which is easily broken up into rather irregular globose to oblong sterile cells with an outer hyaline area and an inner light brown area, 9–12 μ in diameter.

Spores regular, globose, smooth, dark reddish brown, 5–7 μ, in mass forming a dark brown powder.

On *Andropogon* sp.: French West Africa.

3. **Sphacelotheca Doidgeae** Zundel, n. sp.

Sori in the inflorescence usually involving the entire spikelet along the rachis, long linear, frequently irregularly branched or compound, 3–8 mm. long, covered by an evident, thick brown false membrane, which dehisces from the apex disclosing a brown agglutinated mass of spores surrounding a well developed irregular columella.

Evident sterile tissue breaking up into groups or chains of hyaline sterile cells, 6–10 $\mu$ diameter; groups of large globose sterile cells throughout the sori; rather persistent sterile tissue.

Spores globose-subglobose, thick walled, olivaceous, smooth and finely granular under oil immersion, 6–10 $\mu$ diameter.

On *Andropogon* sp.: Edendale, Natal, Union of South Africa, coll. E. M. Doidge, December 26, 1911 (U. D. Agr. Myc. Herb. *1997*). *Andropogon intermedius:* Maritzburg, Natal, Union of South Africa, coll. J. M. Sim, March 15, 1915 (U. D. Agr. Myc. Herb. *8939*). *Andropogon appendiculatus:* Onderspoort, Pretoria, Union of South Africa, coll. A. O. D. Mogg, February 20, 1921 (U. D. Agr. Myc. Herb. *15058*).

4. **Sphacelotheca sorghicola** (Speg.) Zundel, n. comb.

*Ustilago sorghicola* Speg. Anal. Mus. Nac. Buenos Aires III. **1**: 58. 1902.

Sori destroying the ovaries, hypertrophied, 4–6 mm. long, covered by an evident false membrane which flakes away revealing a dark brown spore mass surrounding a well developed columella. Spores 4.5–6 $\mu$ diameter, reddish brown, with an evident hyaline center, globose-subglobose, regular, smooth under oil immersion; sterile cells singly or in short chains, hyaline, globose to subglobose, sometimes angular, 3–9 $\mu$ diameter.

On *Andropogon Sorghum:* Argentina; Malta; Formosa.

5. SPHACELOTHECA CRUENTA (Kuhn) Potter, Phytopath. **2**: 98. 1912.

*Ustilago cruenta* Kuhn, Hamburg Gart. Blumenztig. **28**: 177–178. 1875.

Sori destroying the ovaries, which are scarcely larger than normal, covered with an evident membrane which breaks up into globose cells; groups of large globose cells scattered throughout the sori; as the false membrane flakes away a brown granular spore mass is revealed surrounding a long curved, well developed

columella; sterile cells hyaline, globose-subglobose, singly or in groups, 9–14 $\mu$ diameter; spores globose-subglobose, light reddish brown, smooth, 5–8 $\mu$ diameter.

On *Andropogon halepense:* Anatolia; Tanganyika Territory.

*Andropogon Sorghum* (*Sorghum vulgare*) (*S. saccharatus*): United States (Texas, Wisconsin); Cuba; Haiti; Jamaica: Asia Minor; India.

6. SPHACELOTHECA SORGHI (Link) Clinton, Jour. Myc. **8**: 140. 1902.

*Sorosporium Sorghi* Link, in Willd. Sp. Pl. **6**$^2$: 86. 1825.

Sori destroying the ovaries, which are elongated about twice the normal length of the seed, covered with an evident false membrane which ruptures, revealing a brown spore mass surrounding a short, thick, well developed columella; false membrane usually breaking up into chains of small hyaline cells, subglobose-ellipsoidal, 3–10 $\mu$ diameter; spores reddish brown, globose-subglobose, smooth, 3–8 $\mu$ diameter, mostly about 5 $\mu$ diameter.

On *Andropogon halepensis:* Cuba; India; Mesopotamia; Turkestan. *Andropogon halepensis muticus:* Italy; Caucasia (Georgia); Turkestan. *Andropogon Sorghum* (*Sorghum vulgare*): United States (Alabama, California, Connecticut, District of Columbia, Illinois, Indiana, Iowa, Kansas, Nebraska, New Jersey, New York, Ohio, Oklahoma, Pennsylvania, South Dakota, Utah, Washington, Wisconsin); Canada (Manitoba, Ontario); Cuba; Jamaica; Porto Rico; Argentina; Czechoslovakia; Denmark; Germany; Great Britain (Kew Bot. Garden); Holland; Hungary; Italy; Malta; Roumania; Russia; Spain; Yugoslavia; Abyssinia; Algeria; Egypt; French Congo; Senegal; Soudan; Tanganyika Territory; Union of South Africa; Kenya Protectorate; Caucasia (Georgia); Japan; Philippine Islands; Australia. *Andropogon* (*Sorghum*) sp.: United States (Hawaii); Erythraea; Gold Coast; Kenya Protectorate; Turkestan.

7. **Sphacelotheca Andropogonis-annulati** (Bref.) Zundel, n. comb.

*Ustilago Andropogonis-annulati* Bref. Unters. Gesammt. Myk. **12**: 109. 1895.

Sori destroying the ovaries, about 3 mm. long, at first hidden by the glumes but later protruding by forcing the glumes apart,

covered by an evident false membrane with evanescent sterile cells; spores globose-subglobose, reddish brown, under oil immersion vacuolated, indistinctly echinulate, usually 8–9 μ diameter, but ranging 7–12 μ diameter.

On *Andropogon annulatus:* India.

8. **Sphacelotheca Evansii** Zundel, n. sp.

Sori in the inflorescence, long linear, 5–10 mm. long, inconspicuous, hidden by the glumes, covered by an evident membrane which when broken discloses a dark brown spore mass surrounding a well developed columella.

Groups of sterile cells throughout the sorus; false tissue rather permanent, breaking up into large groups of chains of sterile cells; sterile cells hyaline, irregular, globoid, 9–12 μ diameter.

Spores olivaceous brown, globose-subglobose, regular, usually 8–10 μ, under oil immersion smooth and vacuolated.

On *Andropogon* sp. (*Cymbopogon* sp.): Olifants River, Transvaal, Union of South Africa, coll. I. B. Pole Evans, January 1, 1918 (U. D. Agr. Myc. Herb. *14174*).

9. **Sphacelotheca Nyassae** (H. & P. Sydow) Zundel, n. comb.

*Ustilago Nyassae* H. & P. Sydow, Ann. Myc. **18**: 156. 1920.

Sori destroying the ovaries, which remain about normal size, 5 mm. long, inconspicuous, concealed by the glumes, covered by an evident false membrane which ruptures, revealing a brown powdery spore mass surrounding a simple columella: false membrane breaking up into hyaline, globose sterile cells, 11–16 μ diameter; spores globose-subglobose, sometimes angular, reddish brown, under oil immersion coarsely vacuolated, finely verruculose, 9–12 μ diameter.

On *Andropogon* sp.: Nyassaland Protectorate, Africa.

10. SPHACELOTHECA BARCINONENSIS Fz.-Riof. Bol. Real Soc. Esp. Hist. Nat. **23**: 193. 1923.

Sori destroying the ovaries, concealed by the floral glumes; infected ovaries slightly larger than normal, at first inconspicuous, covered with an evident false membrane which breaks up into globose sterile cells usually in groups or chains, hyaline, 7–12 μ diameter; spores light reddish brown, globose-subglobose, somewhat irregular. contents appearing as if full of oil drops (vacuolated), indistinctly verruculose under oil immersion, 9–12 μ diameter.

On *Andropogon hirtus* var. *longiaristatum:* Spain.

11. **Sphacelotheca Duthiei** (Ricker) Zundel, n. comb.

*Ustilago Duthiei* Ricker, Jour. Myc. **11**: 111. 1905.

Sori in the ovaries, which are scarcely enlarged, inconspicuous, hidden by the glumes, 2–3 mm. long and covered by a false membrane which is more or less evanescent, breaking up into groups or chains of cells or into individual cells which are globose-subglobose, often angular, irregular, hyaline, 7–15 $\mu$ diameter; spores yellowish brown, globose-subglobose, regular, verruculose under oil immersion, 9–12 $\mu$ diameter.

On *Andropogon annulatus* (*A. Bladhii*): India.

12. **Sphacelotheca tonkinensis** (P. Henn.) Zundel, n. comb.

*Uredo tonkinensis* P. Henn. Hedwigia **34**: 11. 1895.

Sori destroying the ovary, 2–3 mm. long, at first concealed by the glumes, covered by a brown false membrane, which dehisces from the apex revealing a brown spore mass surrounding a well developed columella. Spores globose-subglobose, regular, with a thick double wall, reddish brown, the inner part of the spore granular-vacuolate, 9–12 $\mu$ diameter, smooth under oil immersion. Sterile cells hyaline, globose, usually in pairs, each pair about 15 $\mu$ diameter.

On *Andropogon* sp.: Philippine Islands; Tonkin.

This species is described as *Uredo tonkinensis* P. Henn. in Hedwigia **34**: 11. 1895. Saccardo lists it as *Uredo tonkinensis* P. Henn. in Syll. Fung. **11**: 232. 1895, with the genus *Ustilago*, and lists it in the index as *Ustilago tonkinensis* P. Henn.

13. SPHACELOTHECA OCCIDENTALIS (Seym.) Clinton, Jour. Myc. **8**: 141. 1902.

*Sorosporium Ellisii occidentalis* Seym. in Ellis & Everh. N. A. Fungi *2265*. Feb. 1889.

Sori in the ovary, linear, ½–1 cm. long, covered by an evident false membrane which dehisces from the apex disclosing a powdery mass of spores surrounding an evident, well developed columella; sterile cells hyaline, very variable in size and shape, 7–14 $\mu$ diameter, globose-subglobose or rectangular; due to partial gelatinization of false membrane the cells are frequently rather indistinct; spores reddish brown, subglobose, often angled, variable in shape, sometimes mechanically hanging together in clusters but not forming spore balls, minutely verruculose under the oil immersion, 11–16 $\mu$ diameter.

On *Andropogon Hallii:* United States (Kansas, Nebraska). *Andropogon macourus:* United States (California). *Andropogon provincialis* (*A. furcatus*): United States (Kansas, Nebraska, North Dakota).

14. **Sphacelotheca Milbraedii** (H. & P. Sydow) Zundel, n. comb.

*Ustilago Milbraedii* H. & P. Sydow, Wissensch. Ergebn. Deutsch. Zentral Exped. **1907–1908**: 95. 1911.

Sori in the ovaries, long linear, 3–5 cm., covered with an evident false membrane which flakes away disclosing a semi-powdery spore mass with a well formed columella: outer false membrane rather persistent, breaking up into large groups of cells; sterile cells tinted brown, rectangular and in rows; balls of sterile cells throughout the sorus, tinted brown, subglobose, 9–12 $\mu$ diameter; spores irregular, globose-subglobose and sometimes cubical, angled, flattened, tinted brown, with a darker colored oil drop in the center, faintly echinulate under the oil immersion, thin-walled, 3–8 $\mu$ diameter.

On *Andropogon Schoenanthus:* Tanganyika Territory, Africa.

15. SPHACELOTHECA SEYMOURIANA Clinton, Proc. Boston Soc. Nat. Hist. **31**: 387. 1904.

Sori in the ovary, entirely destroying the floral parts, hidden by the glumes, linear, about 5–7 cm. long or about same length as glumes, covered by an evident membrane which ruptures from the apex disclosing a more or less agglutinated spore mass. Sterile cells scattered throughout the sorus and also composing the outer false membrane, not easily broken into individual cells but hanging together in clusters (especially in outer membrane) of six or more cells, more or less globose, those in outer tissue more irregular, 7–12 $\mu$ diameter; spores brown, globose-subglobose, occasionally oblong, angular, sometimes pitted, smooth, 7–12 $\mu$ diameter.

On *Andropogon virginicus:* United States (Alabama, North Carolina). *Andropogon* sp.: United States (Georgia).

16. **Sphacelotheca guaranitica** (Speg.) Zundel, n. comb.

*Ustilago guaranitica* Speg. Anal. Soc. Cien. Argentina **17**: 87. 1884.

Sori in the ovaries, 2–3 cm. long, completely destroying inflorescence, surrounded by an evident false membrane which upon rupturing discloses a dark brown spore mass surrounding a simple columella; spores smooth, rather regular, globose-

subglobose, 11–14 $\mu$ in diameter, yellowish brown; false membrane easily broken up into individual, hyaline, globose-subglobose cells, 7–11 $\mu$ diameter (Rab. Fungi Europ. *4006*).

On *Andropogon condensatus:* Paraguay; Venezuela. *Andropogon* sp.: Venezuela.

17. **Sphacelotheca Stuhlmanni** (P. Henn.) Zundel, n. comb.

*Ustilago Stuhlmanni* P. Henn. Bot. Jahrb. (Engler) **17**: 3. 1893.

Sori in the ovaries, destroying the inflorescence, long linear, usually 7–10 cm. long and covered with an evident brown membrane which flakes off disclosing a brown, more or less agglutinated spore mass; sterile tissue tinted brown, breaking up into large groups of cells; the sterile cells in rows; cells often collapsed; spores globose-subglobose, thick-walled, sometimes angular, minutely echinulate under oil immersion, reddish brown, 9–14 $\mu$ diameter.

On *Andropogon* sp.: Central Africa; Tanganyika Territory.

18. **Sphacelotheca Schoenanthi** (H. & P. Sydow & Butler) Zundel, n. comb.

*Ustilago Schoenanthi* H. & P. Sydow & Butler, Ann. Myc. **4**: 425. 1906

Sori destroying the ovaries, long linear, about 1 cm. long, surrounded by a false membrane which flakes away revealing a brown, semi-agglutinated spore mass and a well formed columella, at first hidden by the sheath; sterile tissue breaking up into large hyaline, globose-subglobose cells, 11–16 $\mu$ diameter; spores regular, globose-subglobose, reddish brown, thick-walled, minutely echinulate under oil immersion, 8–14 $\mu$ diameter.

On *Andropogon Schoenanthus:* India.

19. SPHACELOTHECA MONILIFERA (Ellis & Ev.) Clinton, Jour. Myc. **8**: 141. 1902.

*Ustilago monilifera* Ellis & Ev. Bull. Torrey Club **22**: 362. 1895.

Sori in the ovaries, elongate, often concealed by the glumes, 4–7 mm. long or about the same length as the glumes, covered by rather persistent false membrane which flakes away disclosing a more or less agglutinated brown spore mass and a well developed columella; sterile cells the same size as spores, globose-subglobose, sometimes angled, with a light brownish tint; spores reddish brown, globose-subglobose, sometimes angled, inclined to

collect in groups but not in spore balls, verruculose, 9–12 $\mu$ diameter.

On *Andropogon contortus* (*Heteropogon contortus*): United States (Arizona, Hawaii); Mexico; Tanganyika Territory.

20. **Sphacelotheca Warneckeana** (P. Henn.) Zundel, n. comb.

*Ustilago Warneckeana* P. Henn. Bot. Jahrb. (Engler) **38**: 119. 1905.

Sori in ovaries, long linear, 3–5 mm. long, at first hidden by the glumes, covered by an evident membrane which ruptures disclosing a brown spore mass and a simple or much branched columella; sterile tissue more or less permanent, tinged brown, breaking up into clusters of cells or individual cells; sterile cells globose-subglobose, about the size of the spores; spores olivaceous-reddish brown, globose-subglobose, often irregular, abundantly echinulate, 9–12 $\mu$ diameter.

On *Andropogon contortus* (*Heteropogon contortus*): Camerun, Africa; India.

21. **Sphacelotheca Nardi** (H. & P. Sydow) Zundel, n. comb.

*Ustilago Nardi* H. & P. Sydow, Ann. Myc. **4**: 425. 1906.

Sori in the inflorescence, long linear, about 2–3 mm. long, inconspicuous, covered with a delicate false membrane which flakes away revealing a brown spore mass and a well developed columella, nearly concealed by the floral sheath; false membrane breaking up into groups or chains of rectangular sterile cells, tinted brown, about 5 × 6 $\mu$ diameter; spores globose-subglobose, irregular, light reddish brown, smooth, 5–8 $\mu$ diameter.

On *Andropogon Nardus:* India.

22. **Sphacelotheca tenuis** (H. & P. Sydow) Zundel, n. comb.

*Ustilago tenuis* H. & P. Sydow, Ann. Myc. **4**: 425. 1906.

Sori ½–1 cm. long, destroying the inflorescence, covered with a false membrane which is more or less permanent but when broken reveals a more or less semi-powdery spore mass surrounding a well developed columella; the cells of the sterile tissue fuse and to a large degree lose their cellular structure, appearing as a more or less amorphous mass; some globose cells, however, retain their identity; spores olive brown, globose-subglobose, somewhat irregular and angular, thick-walled, finely granular under oil immersion, smooth, 6–10 $\mu$ diameter.

On *Andropogon pertusus:* India.

23. **Sphacelotheca concentrica** Zundel, n. sp.

Sori in the inflorescence, broadly elongate, 1 cm. or less in length, at first concealed by the subtending bracts, surrounded by an evident light colored false membrane which flakes away revealing a partially agglutinated dark spore mass surrounding a well formed columella.

Sterile tissue breaking up into hyaline globose cells, variable in size, ranging from 10–21 $\mu$ diameter.

Spores globose-subglobose; under oil immersion the spore is divided into four concentric parts, an outer dark brown area, then a light reddish brown area, and an inner vacuolated, light colored area surrounded by a second dark brown area, smooth, 4–8 $\mu$ diameter, usually 6–8 $\mu$ diameter.

On *Andropogon plurinodis* (*Cymbopogon plurinodis*): Pretoria, Union of South Africa, coll. A. O. D. Mogg, November 1, 1917 (U. D. Agr. Myc. Herb. *10708*).

24. **Sphacelotheca Ritchiei** Zundel, n. sp.

Sori in the inflorescence, long linear, 5–8 mm. long; sori gregarious, at first hidden by the glumes, later the upper ends protruding, covered by an evident dark brown false membrane which flakes away from the apex revealing a brown spore mass surrounding a well developed columella.

Sterile cells hyaline, singly, in pairs, in short chains or groups (usually in pairs), usually larger than the spores, ranging from 9–15 $\mu$ diameter, usually 9–12 $\mu$, with the largest single cells 15 $\mu$ diameter, thin-walled and somewhat fragile.

Spores globose-subglobose, reddish brown, regular, under oil immersion minutely verruculate, 6–10 $\mu$ diameter.

On *Andropogon* sp. (*Hyparrhenia cymbaria*): Morogoro, Tanganyika Territory, coll. A. H. Ritchie, January, 1926 (U. D. Agr. Myc. Herb. *20650*).

25. **Sphacelotheca superflua** (H. & P. Sydow) Zundel, n. comb.

*Ustilago superflua* H. & P. Sydow, Ann. Myc. **10**: 249. 1912.

Sori destroying the inflorescence, long linear, 5–8 mm. long, covered by an evident brown false membrane which flakes away revealing a dark brown spore mass surrounding a well developed columella, at first concealed by the sheath but later entirely protruding; false membrane breaking up into globose sterile cells, faintly tinted brown, 11–16 $\mu$ diameter; spores deep reddish brown, subopaque, globose-ellipsoidal, somewhat irregular and frequently angled, echinulate under oil immersion, 11–16 $\mu$ diameter.

On *Andropogon foveolatus:* India.

26. **Sphacelotheca natalensis** Zundel, n. sp.

Sori in the inflorescence, long linear, 3–6 mm. long, covered by an evident brown false membrane which flakes away revealing an agglutinated spore mass surrounding a well developed simple columella.

Sterile cells globose, mostly hyaline, usually in groups or short chains, variable in size, 12–15 $\mu$ diameter, reddish brown en masse.

Spores light reddish brown, globose-subglobose, thin-walled, under the oil immersion smooth, 10–12 $\mu$ diameter.

On *Andropogon* sp.: Mooi River, Natal, Union of South Africa, coll. A. O. D. Mogg, September 4, 1917 (U. D. Agr. Myc. Herb. *11705*).

27. **Sphacelotheca transvaalensis** Zundel, n. sp.

Sori destroying the inflorescence, long, broadly linear, 5–10 mm., surrounded by a heavy dark brown false membrane which flakes away revealing a mass of black spores surrounding a large well developed root-like, branched central columella and many surrounding smaller columellae. (Resembling a small root system of an herbaceous plant.)

Sterile cells globose-subglobose, hyaline, delicate, large, ranging from 11–12 $\mu$ diameter, individual or in short chains.

Spores globose-subglobose, reddish brown, regular in size, under the oil immersion smooth with finely granular contents, 10–12 $\mu$ diameter.

On *Andropogon* sp. (*Sorghum* sp.): Onderste Poort, Pretoria, Transvaal, Union of South Africa, coll. A. O. D. Mogg, January 23, 1919 (U. D. Agr. Myc. Herb. *17047*).

28. SPHACELOTHECA COLUMELLIFERA (Tul.) Ciferri, Ann. Myc. **26**: 32. 1928.

*Cintractia columellifera* (Tul.) McAlp. Smuts of Austral. 166. 1910.

Sori destroying the inflorescence, long linear, 5–7 cm., at first concealed by the sheath but later protruding, covered by an evident yellowish white false membrane which ruptures irregularly revealing a dark brown agglutinated spore mass surrounding a large well developed, hollow columella; false membrane breaking up into groups or chains of globose, hyaline, sterile cells, 7–12 $\mu$ diameter; spores generally globose, regular,

occasionally subglobose, light reddish brown, under oil immersion vacuolated contents, smooth, mostly 7 $\mu$ diameter, sometimes as high as 9 $\mu$.

On *Andropogon australis:* Australia. *Andropogon hirtus* (*Heteropogon hirtus*): Algeria; Madeira Islands; Tanganyika Territory. *Pennisetum cenchroides:* Algeria; Madeira Islands.

29. SPHACELOTHECA CONGENSIS (H. & P. Sydow) Wakefield, in litt.

*Ustilago congensis* H. & P. Sydow, in Wildeman, Etude Fl. Bas.- et Moyen-Congo, I. **3**: 9. 1909.

Sori destroying the inflorescence, long linear, 1–2 cm. long, grouped together, producing a witches' broom effect, at first hidden by the bracts subtending the panicle, covered by an evident thick false membrane more or less persistent breaking up into groups or chains of sterile cells which adhere rather firmly; sterile cells hyaline, thick-walled, globose-broadly ellipsoidal, 7–10 $\mu$ diameter and up to 14 $\mu$ long for the ellipsoidal cells; spores medium to light reddish brown, globose-subglobose, sometimes broadly ellipsoidal, somewhat irregular as to size, mostly 5–8 $\mu$ or rarely up to 10 $\mu$ diameter, minutely verruculose under oil immersion (Ex-Herb. Hort. Bot. Reg. No. *3056* & *4412*).

On *Andropogon* sp.: Congo.

30. **Sphacelotheca bicornis** (P. Henn.) Zundel, n. comb.

*Ustilago bicornis* P. Henn. Hedwigia **35**: 50. 1896.

Sori in the inflorescence, long linear, forming a witches' broom growth, covered with an evident reddish brown false membrane, 1–2 cm., destroying nearly all of the inflorescence; numerous sori grouped together at point of the development of inflorescence; sterile tissue surrounding the sori which breaks up into subglobose sterile cells which frequently hold together in groups, about the size of the spores, sometimes tinted brown; spores light reddish brown, rather irregular, globose-ellipsoidal, often angular, verruculose under oil immersion, 7–12 $\mu$ diameter.

On *Andropogon bicornis:* Brazil.

31. **Sphacelotheca Dinteri** (H. & P. Sydow) Zundel, n. comb.

*Ustilago Dinteri* H. & P. Sydow, Ann. Myc. **13**: 37. 1915.

Sori destroying the entire inflorescence, almost entirely hidden by the terminal sheath, long linear, 2–4 cm. long, covered by an evident brown false membrane which flakes away revealing a

semi-powdery, brown spore mass surrounding a well formed columella; sterile tissue composed of globose cells, faintly tinted brown, breaking up into groups of cells or into individual cells 7–12 μ diameter, globose-subglobose, sometimes ellipsoidal; spores olive brown, globose-subglobose, sometimes ellipsoidal, frequently angled, thick-walled, finely granular, smooth, 9–12 μ diameter.

On *Andropogon papillosus:* South West Africa.

32. SPHACELOTHECA LANIGERI (Magn.) Maire, in litt.

*Ustilago Lanigeri* P. Magn. Verhandl. Zool.-Bot. Gesell. Wien **49**: 88. 1899.

Sori almost completely hidden within the glumes, covered by an evident false membrane which splits longitudinally disclosing a dark brown spore mass, completely destroying the inner floral parts, about 1–1½ cm. long; false membrane adhering rather firmly in groups and rarely breaking into individual cells; sterile cells irregular in size and shape globose-subglobose, sometimes angular, 8–18 μ diameter; spores globose, regular, reddish brown, smooth, 5–8 μ diameter, occasionally 12 μ.

On *Andropogon laniger:* Morocco; Persia.

33. SPHACELOTHECA ANDROPOGONIS (Opiz) Bubak, Naturw. Landes. Böhmen. **15**: 25. 1916.

*Sphacelotheca Ischaemi* (Fuckel) Clinton, Jour. Myc. **8**: 140. 1902.

Sori usually involving entire inflorescence, long linear, hidden by sheath, 10–40 mm. long, 1–4 mm. wide, covered with a false membrane which flakes away disclosing a brown spore mass and a well developed columella; false membrane rather permanent, breaking up into large masses of tissue rather than individual cells; sterile tissue also scattered throughout the sori; sterile cells globose-subglobose, flattened when in contact with each other, 7–16 μ diameter, usually hyaline or tinted brown en masse; spores medium reddish brown, globose-subglobose, smooth and minutely granular, 8–11 μ diameter.

On *Andropogon contortus* (*Heteropogon contortus*): United States (Arizona); Mexico; Erythrea; Philippine Islands. *Andropogon distachyos:* France; Spain. *Andropogon foveolatus:* Egypt. *Andropogon furcatus:* United States (Kansas). *Andropogon halepensis:* Philippine Islands. *Andropogon hirtus:* Czechoslovakia; Spain; Congo. *Andropogon hirtus longiaristata:* Spain. *Andropogon hirtus pubescens:* Spain; Anatolia (Smyrna). *Andropogon*

*Ischaemum:* Austria; Bulgaria; Germany; Greece; Poland; Roumania; Spain; Switzerland; Yugoslavia (Serbia); Congo; Persia. *Andropogon Ischaemum longiaristatum:* Czechoslovakia; Hungary; Italy; Spain. *Andropogon Iwarancusa* (*A. proximus*): Erythrea. *Andropogon pubescens:* Malta; Congo; Tunis; Syria; Palestine. *Andropogon saccharoides:* Mexico. *Andropogon scoparius:* United States (Illinois). *Andropogon Torreyanus:* United States (Arizona, Texas). *Andropogon* sp.: United States (Arizona) Czechoslovakia; Central Africa; Congo; Tanganyika Territory; Tripoli; Union of South Africa. *Cymbopogon excavatus:* Union of South Africa. *Ischaemum timorense:* tropical Africa. *Pennisetum dichotonum:* Egypt.

34. **Sphacelotheca Zilligii** Zundel, n. sp.[3]

Sori in the inflorescence, solitary, long linear, 1–3 cm. long, at first concealed by the sheath, covered by an evident brown false membrane which flakes away revealing a dark brown granular spore mass surrounding a well developed much branched columella.

Sterile cells globose-subglobose, hyaline, usually adhering in groups or chains, angular by compression—variable in size, ranging from 8–14 $\mu$ diameter.

Spores globose-subglobose, semi-regular, light reddish brown, medium echinulate under the oil immersion, 7–10 $\mu$ diameter.

On *Andropogon* sp.: Sryberg, Union of South Africa, coll. A. O. D. Mogg, March 25, 1921 (U. D. Agr. Myc. Herb. *20666*).

35. **Sphacelotheca Kellermanii** Clinton & Zundel, n. sp.

Sori in the inflorescence, bunched and forming a witches' broom effect but individual sori linear-elongated, usually 2–4 cm. in length; sterile membrane conspicuous, breaking irregularly into elongated strips (disclosing dusty spore mass and eventually the elongated recurved columella of plant tissues) but not separating easily into the individual cells (hyaline to reddish brown tinted), which are chiefly oblong to cubical and smaller than the spores; spores dark reddish brown, subopaque, angular, irregularly oblong to subspherical, evidently granular-verruculose under immersion lens, 10–16 $\mu$, rarely 18–20 $\mu$, in length.

On *Andropogon leucostachyus:* Guatemala, Central America.

This species is closely related to *Sphacelotheca Holwayi* on *Andropogon bicornis* but differs in the occasionally more elongated

[3] Named for Dr. Hermann Zillig, German Ustilaginalogist.

spores and in the more evident granular verruculations. It is even more distinct from *Sphacelotheca* (*Ustilago*) *leucostachys* on the same host since the latter has quite regular subspherical, larger spores and a simple sorus. This description is based on three collections made by W. A. Kellerman in Los Amates, Guatemala, March 15, 1905, January 15 and February 15, 1908. The host was determined by Agnes Chase.

36. **Sphacelotheca Holwayi** Clinton & Zundel, n. sp.

Sori in the inflorescence, bunched and forming witches' broom effect with individual sori linear-elongated, usually 2–4 cm. in length; sterile membrane conspicuous, breaking irregularly into elongated strips (disclosing spore mass and eventually elongated recurved remains of plant tissue) but not separating easily into the individual, hyaline (with age tinted reddish brown) cells which are chiefly oblong to cubical and smaller than the spores; spores dark reddish brown, subopaque, angular, irregularly oblong to subspherical, obscurely granular-verruculose under immersion lens, 10–16 $\mu$, or most elongated rarely 18 $\mu$ in length.

On *Andropogon bicornis:* Bolivia, South America.

Closely related to *Sphacelotheca Kellermanii* on *Andropogon leucostachyus*, collected by Kellerman in Guatemala (nos. *7601, 6501a, 7252*, U. S. Dept. Agr. Herb.) but differs in the less elongated spores and less evident granular verruculations but otherwise similar and from *Sphacelotheca culmiperda* on same host, *Andropogon bicornis*, even more through the witches' broom-like sorus and the more irregular and smaller spores. *Ustilago* (*Sphacelotheca*) *bicornis*, also on *Andropogon bicornis*, has a similar compound sorus with witches' broom effect but the spores are decidedly smaller and lighter colored. We find no species it agrees with exactly and so have described it as new. This description is based on a collection (in Clinton Herbarium) by W. E. D. and Mary M. Holway (Plants S. A. no. *686*) made May 31, 1920, at Villa Aspiazu, Provincia de sur Yungas, Bolivia. The host was determined by Dr. A. S. Hitchcock.

37. **Sphacelotheca culmiperda** (Schröt.) Clinton, n. comb.

*Ustilago culmiperda* Schröt. Hedwigia **35**: 212. 1896.

Sori destroying the floral parts, long linear, 3–6 cm. long, at first hidden by the terminal leaf sheath but later more or less exposed, covered by an evident dark brown membrane which

flakes off revealing a brown spore mass surrounding a well developed columella. Sterile tissue more or less permanent, breaking up into chains of cells; sterile cells reddish brown, subglobose to ellipsoidal. The subglobose cells scattered throughout the sorus as short chains of cells and about the size of the spores; the cells of the outer false tissue more elongate and angular, about 5–13 $\mu$; spores deep reddish brown, subopaque, globose-subglobose or flattened ellipsoidal due to an appression on one side, regular, under oil immersion lens abundantly verruculose and granular, 13–19 $\mu$ diameter.

On *Andropogon bicornis:* Brazil. *Andropogon* sp.: Brazil.

38. **Sphacelotheca leucostachys** (P. Henn.) Zundel, n. comb.

*Ustilago leucostachys* P. Henn. Hedwigia **35**: 50. 1896.

Sori in the inflorescence, long linear, 5–7 cm. long, at first concealed by the sheath but later protruding as a long, linear, curled body, covered with a light brown false membrane which flakes away revealing a brown spore mass surrounding a long thick well developed columella extending the length of the sorus; false membrane composed of rectangular cells in chains which break up either singly or adhere in chains, tinted brown, 9–14 $\times$ 5–7 $\mu$; spores dark reddish brown, globose-subglobose, regular, opaque, obscurely but abundantly, minutely verruculose under oil immersion, 13–17 $\mu$ diameter.

On *Andropogon leucostachyus:* Brazil.

39. SPHACELOTHECA ANDROPOGONIS-HIRTIFOLII (P. Henn.) Clinton, Jour. Myc. **8**: 141. 1902.

*Ustilago Andropogonis-hirtifolii* P. Henn. Bot. Gaz. **28**: 274. 1899.

Sori destroying the entire inflorescence and occupying more or less of the entire panicle, forming large irregular bodies, 5–9 cm. long, at first hidden by the sheath, covered by an evident false membrane which gradually flakes away disclosing a more or less agglutinated brown spore mass which gradually becomes powdery; false membrane breaking up into groups of cells rather than individual cells; groups of sterile cells throughout the sorus, hyaline, globose-subglobose, 7–13 $\mu$ diameter; spores globose-subglobose, sometimes angled, reddish brown, minutely verruculose under oil immersion, 9–14 $\mu$ diameter.

On *Andropogon hirtifolius pubiflorus:* Mexico. *Andropogon saccharoides:* United States (Arizona).

SOROSPORIUM Rud. Linnaea 4: 116. 1829

Sori on the leaves. . . . . *S. Wildemanianum*
Sori in the inflorescence.
  Sori less than 1 cm. long.
    Spores with thick yellowish walls, vacuolated. . . . . *S. pretoriaense*
    Spores light reddish brown.
      Spore balls 59–114 μ diameter. . . . . *S. Holstei*
      Spore balls 142–190 μ diameter. . . . . *S. austro-africanum*
  Sori 1–3 cm. long.
    Spores small, 7–12 μ diameter.
      Spore balls small, 40–70 μ. . . . . *S. Healdii*
      Spore balls large, 50–125 μ. . . . . *S. Everhartii*
    Spores large, 9–16 μ or more diameter.
      Spores papillate. . . . . *S. filiferum*
      Spores verruculose. . . . . *S. Ellisii*
      Spores echinulate.
        Spores irregular, angled. . . . . *S. tumefaciens*
        Spores regular.
          Spore balls with 10–20 spores. . . . . *S. icosiense*
          Spore balls with many spores.
            Sori hypertrophied, 5–7 mm. thick. . . . . *S. Ehrenbergii*
            Sori long, linear. . . . . *S. Tembuti*
  Sori more than 3 cm. long.
    Sori irregular, causing destruction of either male or female inflorescence.
      Spore balls 45–60 μ diameter, permanent. . . . . *S. proliferatum*
      Spore balls 75–150 μ diameter, temporary. . . . . *S. Reilianum*
    Sori regular.
      Spores 11–20 μ diameter.
        Spores globose-subglobose. . . . . *S. provinciale*
        Spores angled. . . . . *S. geminellium*
      Spores 8–10 μ, echinulate. . . . . *S. Hodsonii*
    Sori tubular, stuffed with spores. . . . . *S. filiformis*
    Sori not tubular.
      Spores verruculose.
        Sori clustered as a "witches' broom". . . . . *S. Clintonii*
        Sori single, long linear.
          Spores dark brown to hyaline. . . . . *S. contortum*
          Spores light yellowish brown. *S. maranguense*
          Spores pitted. . . . . *S. Heteropogonis-contorti*[4]
        Sori solitary, large, 5–6 mm. wide. . . . . *S. harrismithense*

Spores echinulate.
- With large internal, hyaline balls of sterile cells..... *S. Simii*
- Without internal balls of sterile cells.
  - Spores ranging from reddish brown to hyaline. *S. caledonicum*
  - Spores even colored, dark reddish brown..... *S. Flanaganianum*
  - Spores globose-angular..... *S. dembianense* [4]

Spores smooth.
- Spores 4–6 $\mu$ diameter.. *S. Andropogonis-aciculati*

1. SOROSPORIUM WILDEMANIANUM P. Henn. Ann. Mus. Congo V. **2**: 87. 1907.

Sori on the leaves occurring as small erumpent pustules covered with the epidermis, which upon rupturing discloses a dark brown spore mass; spore balls opaque, dark reddish brown, 50–80 spores, ellipsoidal-subellipsoidal, 70–114 $\mu$ diameter; spores fragile, dark reddish brown, minutely echinulate under the oil immersion, globose-subglobose, often and somewhat angular, 7–14 $\mu$ diameter.

On *Andropogon Martini:* India. *Andropogon* sp.: Congo. *Chloris polydactyla:* Congo.

2. **Sorosporium pretoriaense** Zundel, n. sp.

Sori in the inflorescence 3–8 mm. long, broad at the base, covered with a delicate false membrane which flakes away revealing a brown granular spore mass surrounding a well developed columella.

Spore balls broadly ellipsoidal, opaque, dark reddish brown, containing many spores, temporary, usually 38–66 $\mu$ diameter, rarely 85 $\mu$ diameter.

Spores globose-subglobose, light olivaceous brown under the oil immersion, with a thick yellowish wall and a granular to vacuolated contents, smooth—5–7 $\mu$ diameter.

On *Andropogon dichrous* (*Cymbopogon dichrous*), Pretoria, Union of South Africa, coll. I. B. Pole Evans, March 14, 1917 (U. D. Agr. Myc. Herb. *10045*).

[4] No material available for examination.

3. SOROSPORIUM HOLSTEI P. Henn. Pflanzenw. Ost-Afrikas Nachb. **C**: 49. 1895.

Sori in the inflorescence, long linear, 7 mm. long, covered by an evident false membrane which flakes away revealing a brown granular spore mass surrounding a well developed columella.

Spore balls subglobose-broadly ellipsoidal, opaque, with many spores, 50–114 $\mu$ diameter.

Spores globose-subglobose or rarely ellipsoidal, light reddish brown, under the oil immersion smooth, 5–8 $\mu$ diameter.

On *Andropogon hirtus:* Union of South Africa (Nyassaland). *Anthistiria Forskalii* (*Themeda Forskalii; T. triandra*): Tanganyika Territory; Union of South Africa (Transvaal).

4. **Sorosporium austro-africanum** Zundel, n. sp.

Sori in the inflorescence, long linear, 5–8 mm. long, solitary, covered by an evident yellowish false membrane which dehisces at the apex disclosing a mass of granular spores surrounding a well developed columella.

Spore balls semi-opaque, usually broadly ellipsoidal, usually 142–190 $\mu$ in diameter but sometimes as small as 47 $\mu$, semi-permanent, containing a large number of spores, reddish brown.

Spores light reddish brown to almost hyaline, thick-walled; spores usually smooth except the outer spores, which are somewhat verruculose under the oil immersion, 5–10 $\mu$ diameter.

On *Andropogon cymbarius* (*Cymbopogon elegans*): Tugela River, Natal, Union of South Africa, coll. E. M. Doidge, May, 1920 (U. D. Agr. Myc. Herb. *14168*).

This species differs from *S. pretoriaense* by having thicker-walled spores, which do not have a vacuolated contents and by having larger and more permanent spore balls.

5. **Sorosporium Healdii** Zundel,[5] n. sp.

Sori in the inflorescence, usually concealed by the glumes, attacking the individual flowers and en masse producing a witches' broom-like growth, 2–3 cm. long and covered with a yellowish to brown colored false membrane which dehisces from the apex revealing numerous shreds.

Spore balls opaque, dark brown, globose-broadly ellipsoidal, somewhat irregular, permanent, 30 or more spores, usually 40–70 $\mu$ diameter but occasionally 90 $\mu$ diameter.

Spores globose-subglobose or very broadly ellipsoidal, ranging

[5] Named for Frederick DeForest Heald, Ph.D., American Economic Ustilaginalogist.

from reddish brown for the outer spores to almost hyaline for spores on the inner part of spore ball, thick-walled, sparsely verruculose under oil immersion, usually 6–10 μ diameter.

On *Andropogon cymbarius* (*Cymbopogon elegans*): Pretoria, Union of South Africa, coll. I. B. Pole Evans, May 7, 1916 (U. D. Agr. Myc. Herb. *9732*).

This species is very closely related to *Sorosporium Clintonii* but differs in the shorter light colored sori, smaller and more regular spore balls and smaller spores. The spore balls are about the same size as in *Sorosporium contortum* but the spores are smaller in this new species. The spore balls of *S. Everhartii* are larger than in this species.

6. SOROSPORIUM EVERHARTII Ellis & Gall. Jour. Myc. **6**: 32. 1890.

Sori in the inflorescence, long linear, 1–2 cm. long, ½ cm. wide, at first concealed by the glumes, covered with an evident false membrane which dehisces from the apex revealing a granular dark brown spore mass; spore balls globose-ellipsoidal, opaque, dark reddish brown, rather permanent, consisting of many spores, 40–125 μ diameter; spores globose-subglobose, somewhat irregular and angled, the spores on the outer part of the spore ball reddish brown, those on the inner part lighter (almost hyaline) in color, the free surface of the outer spores verruculose, otherwise smooth, under the oil immersion, 7–12 μ diameter.

On *Andropogon brachystachyus:* United States (Florida). *Andropogon diplandrus:* Congo. *Andropogon macourus:* United States (Florida). *Andropogon scoparius:* United States (Alabama, Connecticut). *Andropogon virginicus:* United States (Alabama, Georgia, Mississippi, New Jersey). *Gayana densiflora:* Congo. *Paspalum scobiculatum:* Congo.

7. **Sorosporium filiferum** (W. Busse) Zundel, n. comb.

*Tolyposporium filiferum* W. Busse, Arb. Biol. Abt. Landw.-Forstw. Kaiserl. Gesundsheit **4**: 383. 1904.

Sori destroying the ovaries, cylindrical elongated, 1–3 cm. long and 5–10 mm. wide, often curved at the end, covered with a thick membrane which ruptures from the tip downward revealing long dark brown shreds and spore masses. Spore balls rather permanent, composed of many spores, 55–115 μ diameter, dark brown, opaque, subglobose-oblong; spores from inner part of

spore balls light yellowish brown, smooth, those from the outer portions of spore balls dark brown and papillate on the free side, globose-subglobose, 9–14 $\mu$ diameter.

Sori surrounded by an evident false membrane which breaks up into long linear cells.

On *Andropogon Sorghum:* Egypt; India; Kenya Protectorate; Union of South Africa; India; Mesopotamia.

8. SOROSPORIUM ELLISII Winter, Bull. Torrey Club **10**: 7. 1883.

Sori in the inflorescence, long linear, 1–2 cm. long, confined to the individual spikelets, covered with an evident membrane which shreds away revealing a dark brown granular spore mass, at first hidden by the sheath but later the end of the sori project from beneath the sheath; spore balls reddish brown, globose-subglobose, somewhat irregular, subopaque, with 30 or more spores, rather permanent, 40–100 $\mu$ diameter; spores light reddish brown, globose-ellipsoidal, angular, irregular, verruculose under oil immersion, 9–16 $\mu$ diameter.

On *Andropogon scoparius:* United States (Connecticut, Illinois, Kansas). *Andropogon virginicus:* United States (New Jersey). *Aristida dichotoma:* United States (Ohio, Pennsylvania).

9. **Sorosporium tumefaciens** (P. Henn.) Zundel, n. comb.

*Ustilago tumefaciens* P. Henn. Pflanzenw. Ost-Afrikas Nachb. **C**: 48. 1895.

Sori destroying the inflorescence, long linear, 1–1½ cm. long, concealed by the smaller floral sheaths, covered with an evident false membrane which flakes away revealing a black brown granular mass of spores; spore balls containing many spores, opaque, irregular, globose-ellipsoidal, rather permanent, dark brown, 55–85 $\mu$ diameter; spores reddish brown with the spores of the interior of the spore ball lighter color, irregular, globose-ellipsoidal, angular, generally smooth but outer spores echinulate on the free surface under oil immersion, 9–12 $\mu$ diameter.

On *Andropogon rufus:* French Congo. *Andropogon* sp.: Tanganyika Territory.

10. SOROSPORIUM ICOSIENSE Maire, Bull. Soc. Hist. Nat. Afr. Nort. **7**: 145. 1917.

Sori in the ovary, completely destroying the floral parts and covered with an evident membrane, which upon rupturing discloses a dark brown spore mass; spore balls containing 10–70

spores, dark reddish brown, globose-oblong or subglobose, 17–60 μ diameter; spores light reddish, globose-ellipsoidal, often somewhat angular, echinulate on the free surface under oil immersion, 9–12 μ diameter.

On *Andropogon distachyos:* Spain; Algeria.

11. SOROSPORIUM EHRENBERGII Kühn, Mitth. Ver. Erdkunde (Halle) **1877**: 87. 1877.

*Tolyposporium Ehrenbergii* (Kühn) Jacz. Russian Auct.

Sori destroying the ovaries, 15–20 mm. long, scattered singly throughout the panicle as hypertrophied ovaries which are covered with an evident false membrane which easily breaks up into globose-oblong, hyaline, sterile cells, 9–19 μ diameter; spore balls containing a large number of spores, globose-oblong, sometimes irregular, dense, reddish brown, fairly permanent but easily broken, usually 49–64 μ but sometimes 104 μ diameter; spores globose-subglobose; spores on interior part of ball tinted brown, those on outside light reddish brown, echinulate, 9–12 μ diameter.

On *Andropogon Sorghum:* Turkestan; Egypt.

12. SOROSPORIUM TEMBUTI P. Henn. & Pole Evans, Bot. Jahrb. (Engler) **41**: 270. 1908.

Sori in the ovaries and stamens, destroying them; in the ovary the sorus is covered with a false membrane which breaks up into sterile cells, revealing a granular mass of brown spore balls and a well developed columella; spore balls dark brown, opaque, with 60 or more spores, globose-oblong, usually 40–90 μ diameter; spores globose-subglobose, sometimes angled, echinulate on the free surface of outer spores of balls, otherwise smooth, medium to light reddish brown, the spores on the inner part of the spore ball being lighter colored than those near the outer part, 9–11 μ diameter, rarely 14 μ.

On *Andropogon cymbosus:* Union of South Africa. *Andropogon excavatus* (*Cymbopogon excavatus*): Union of South Africa. *Andropogon validus* (*Cymbopogon validus*): Union of South Africa. *Andropogon* sp.: Congo.

13. **Sorosporium proliferatum** Zundel, n. sp.

Sori causing large proliferations in the inflorescence resembling miniature ears of corn, concealed by numerous large outer glumes, 2–8 cm. long, covered by an evident false membrane which flakes away revealing a dark brown mass of granular spore balls and a large number of long dark shreds.

Spore balls globose, ellipsoidal, sometimes angled, opaque, with many spores, permanent, usually 45–60 μ diameter, sometimes up to 85 μ diameter.

The spores in the outer part of the spore ball dense, dark reddish brown, while the inner spores are nearly hyaline, somewhat irregular in size and shape, ranging from globose-subglobose, occasionally angled. Mostly 9–22 μ diameter, abundantly verruculose under oil immersion.

On *Andropogon hirtus:* Waterval Boven, Union of South Africa, coll. I. B. Pole Evans, November 29, 1918 (U. D. Agr. Myc. Herb. *11336*).

This smut is very distinctive in the formation of proliferated sori very similar to those produced by *Sorosporium Reilianum* on *Zea Mays* but differs in the permanent and smaller spore balls. It may be the parent of *Sorosporium Reilianum*.

14. SOROSPORIUM REILIANUM (Kühn) McAlp. Smuts of Austral. 181. 1910.

*Sphacelotheca Reiliana* (Kühn) Clinton, Jour. Myc. **8**: 141. 1902.

Sori occurring in either ♀ or ♂ inflorescence, usually causing complete destruction, covered with an evident membrane of host tissue which ruptures disclosing a brown spore mass and numerous columella; the sori are frequently covered by proliferations of the tassel or ear; spore balls irregular in shape, generally opaque, dark reddish brown, easily disintegrating at full maturity of spores; spore balls found only in young specimens, 76–150 μ diameter; spores reddish brown, globose-subglobose, occasionally somewhat angled, thick-walled, abundantly echinulate under oil immersion, 9–14 μ diameter.

On *Andropogon arundinaceus:* Tanganyika Territory; Toso. *Andropogon halepensis:* Italy; Sudan; Union of South Africa; India; Caucasia (Georgia). *Andropogon Sorghum:* United States (California, Nebraska, New Jersey, New Mexico, Ohio, Texas, Utah, Washington); Bulgaria; Czechoslovakia; Germany; Italy; Russia; Spain; Yugoslavia (Serbia); Egypt; Tanganyika Territory (Usambara); Caucasia (Georgia); India; Japan; Turkestan; *Andropogon* sp. (*Sorghum* sp.): Hawaii; Philippine Islands. *Sorghum caudatum:* Kenya Protectorate. *Zea Mays:* United States (California, Kansas, Ohio, Washington); Azores Islands; Czechoslovakia; Germany; Hungary; Portugal; Russia; Egypt. Kenya Protectorate; Union of South Africa; Australia.

15. SOROSPORIUM PROVINCIALE (Ellis & Gall.) Clinton, Jour. Myc. **8**: 145. 1902.

*Sorosporium Ellisii provinciale* Ellis & Gall. Jour. Myc. **6**: 31. 1890.

Sori in the inflorescence, long linear, 6–8 cm. long, entirely hidden by the sheath or sometimes the end partially protruding, covered by a false membrane which flakes away revealing a dark brown powdery spore mass; spore balls globose, somewhat irregular, containing more than 30–40 spores, reddish–dark reddish brown, sometimes opaque, fairly permanent, 45–105 $\mu$ in diameter; spores reddish brown, globose-subglobose, evenly thick-walled, 3–4 $\mu$, verruculose under the oil immersion, 11–20 $\mu$ diameter.

On *Andropogon provincialis* (*A. furcatus*): United States (Missouri, Nebraska).

16. SOROSPORIUM GEMINELLIUM H. & P. Sydow & Butler, Ann. Myc. **10**: 253. 1912.

Sori completely destroying the inflorescence, solitary, long linear, 2–7 mm. long, at first hidden by the sheath, covered by an evident false membrane which upon rupturing reveals a dark brown granular mass of spores surrounding a well formed columella; spore balls opaque, deep reddish brown, globose-subglobose, consisting of more than 15 spores, semi-permanent, usually breaking down soon after maturity, usually 35–50 $\mu$ diameter but occasionally 60 $\mu$ diameter; spores reddish brown, sometimes globose, usually angular, polygonal or triangular, apparently smooth but indistinctly verruculose under the oil immersion, 12–17 $\mu$ diameter.

On *Andropogon* sp.: India.

17. **Sorosporium Hodsonii** Zundel,[6] n. sp.

Sori in the inflorescence, solitary, large, 3–5 cm. long, at first hidden by the outer sheath, covered by an evident membrane which flakes away revealing a brownish granular spore mass intermixed among the shreds.

Spore balls globose-ellipsoidal, reddish brown, semi-opaque, semi-permanent, variable in size, ranging from 50–115 $\mu$ diameter, with many spores.

Spores globose-subglobose, often somewhat angled, light reddish brown, thick-walled, vacuolated contents, abundantly echinulate under oil immersion, 8–10 $\mu$ diameter.

[6] Named for Dr. John W. Hodson, American Mycologist.

On *Andropogon* sp.: Hopefield (Lawley post office), Union of South Africa, coll. not known, February 2, 1910 (U. D. Agr. Myc. Herb. *704*).

18. **Sorosporium filiformis** (P. Henn.) Zundel, n. comb.

*Ustilago filiformis* P. Henn. Bot. Jahrb. (Engler) **34**: 254. 1901.

Sori destroying the inflorescence and forming into long tubular structures 4–8 cm. long, stuffed with spores. The tubular structure consists of a covering of false tissue which breaks up into long shreds or rows of cells. Spore balls consisting of many spores, globose-ellipsoidal, opaque, dark brown, rather permanent and surrounded by a distinct halo, 60–125 $\mu$ diameter; spores deep reddish brown, globose-subglobose; spores on inner parts of spore ball more or less hyaline, thick-walled, verruculose (especially the free surfaces of the outer spores) under oil immersion, 9–12 $\mu$ diameter.

On *Andropogon contortus* (*Heteropogon contortus*): Africa.

19. **Sorosporium Clintonii** Zundel,[7] n. sp.

Sori in the inflorescence, large, 2–6 cm. long and often 5 mm. wide, at first concealed by the glumes, covered with a dark brown false membrane. Sori attacking individual flowers and en masse producing a witches' broom-like growth; shreds appear as false membrane flakes away.

Spore balls irregular, globose-oblong and often angled so that they are often more or less rectangular, dark reddish brown, opaque, permanent, mostly 66–114 $\mu$ but ranging from 47–133 $\mu$ diameter, containing many spores.

Spores on the outer portion of the spore ball dark reddish brown while those on the interior are only tinted brown; thick cell wall about 1.5 $\mu$ thick, irregular in shape but mostly globose-subglobose, frequently angled, verruculose under oil immersion; spores 8–17 $\mu$.

On *Andropogon cymbarius* (*Cymbopogon elegans*): Waterhloof, Pretoria, Union of South Africa, coll. I. B. Pole Evans, April 14, 1916 (U. D. Agr. Myc. Herb. *9693*).

This species is closely related to *Sorosporium contortum* but differs in the more irregular, larger, angular spore balls, in the production of witches' broom-like sori and in the dark brown false membrane covering the sori.

[7] Named for Dr. George Perkins Clinton, American authority on Ustilaginales.

20. SOROSPORIUM CONTORTUM Griff. Bull. Torrey Club **35**: 148. 1908.

Sori in the ovaries, long linear, 3–5 cm. long, completely destroying inflorescence, at first hidden by the sheath, covered with a thick light colored false membrane which flakes away disclosing a brown granular spore mass; spore balls dark brown, opaque, globose-oblong, 47–91 $\mu$ diameter; sterile tissue firmly bound together; sterile cells long angular, often 2–3 times as long as broad, sometimes cubical, thick-walled; spores dark reddish brown on outer portion of spore ball while those on the interior are scarcely colored, globose-subglobose, 9–13 $\mu$ diameter; outer spores verruculose, otherwise smooth.

On *Andropogon contortus* (*Heteropogon contortus*): United States (Arizona, New Mexico).

21. SOROSPORIUM MARANGUENSE P. Henn. Pflanzenw. Ost-Afrikas Nachb. **C**: 49. 1895.

Sori in the inflorescence at first covered by the leaf sheaths; finally tips of sori protrude beyond the sheath, covered by an evident membrane, long linear, shredded, 3–6 cm. long.

Spore balls subglobose, angular, many-spored, 35–65 $\mu$, semi-permanent.

Spores angular, subglobose, irregular, under oil immersion granular contents, verruculose (at least the outer spores), light reddish brown (almost a yellow), the thick spore wall darker reddish brown, 10–14 $\mu$ diameter.

On *Andropogon lepidus* (*A. cymbarius*): Tanganyika Territory.

22. SOROSPORIUM HETEROPOGONIS-CONTORTI Baccarini, Ann. Bot. (Italy) **14**: 132. 1917.

Sori infecting the inflorescence, oblong-linear, included in a smooth grayish yellow sheath; spore balls globose, many-spored, 40–45 to 40–70 $\mu$, dark; spores globose, olive brown, smooth, internally pitted, 9.6–11.2 $\mu$ diameter.

On *Andropogon contortus:* Abyssinia.

23. **Sorosporium harrismithense** Zundel, n. sp.

Sori in the inflorescence, long, large, 3–4 cm. long, 5–6 mm. wide, solitary, surrounded by a brown false membrane which flakes away from the apex revealing a shredded mass of plant tissue and a brown granular mass of spores.

Spore balls globose-subglobose, opaque, semi-permanent, dark reddish brown, 47–105 $\mu$ diameter.

Spores globose to broadly ellipsoidal, angular, reddish brown, with thick cell wall, echinulate under oil immersion, 10–14 $\mu$ diameter.

On *Andropogon* sp.: Harrismith, Union of South Africa, coll. C. P. v. d. Merwe, February 22, 1911 (U. D. Agr. Myc. Herb. *1473*).

24. SOROSPORIUM SIMII P. Henn. & Pole Evans, So. Afr. Jour. Sci. **12**: 543. 1916.

Sori destroying the inflorescence, long linear, 5–7 cm. long, 1–2 cm. wide, dark brown and covered with a false membrane which flakes away disclosing long brown shreds in which the spores are produced; spore balls globose-subglobose, opaque, containing many spores and easily disintegrating; sterile tissue rather permanent, breaking up chiefly into groups or sometimes chains of cells, rarely as individual cells, tinted brown to dark brown; sterile cells about the size of the spores; distinctive globose groups of 4–6 spores scattered throughout the sori, 19–36 $\mu$ diameter; spores olivaceous to reddish brown, globose-subglobose, abundantly but finely echinulate under oil immersion and granular, 9–13 $\mu$ diameter.

On *Andropogon halepensis:* Union of South Africa (Natal).

25. SOROSPORIUM CALEDONICUM Pat. Bull. Soc. Myc. (France) **3**: 173. 1887.

Sori at first concealed by the sheath, 3–5 cm. long, shredded, with the ends of the shreds finally protruding.

Spore balls rather firm, not easily disintegrated, irregular, globose to ellipsoidal, often angular, containing 30–90 or more spores, 30–104 $\mu$ in diameter, reddish brown.

Spores globose-subglobose, regular, minutely echinulate under the oil immersion lens, reddish brown, 9–12 $\mu$ in diameter.

26. **Sorosporium Flanaganianum** Zundel, n. sp.

Sori in the inflorescence, broad, long linear, 2–4 cm. long, solitary, surrounded by a thick brown false membrane which flakes away revealing fine shreds and a brown granular spore mass.

Spore balls globose-subglobose, opaque, with many spores, dark reddish brown, semi-permanent, usually 75–95 $\mu$, seldom as small as 47 $\mu$..

Spores subglobose, irregular, angled, reddish brown, abundantly echinulate under oil immersion, usually 10–14 $\mu$ diameter.

On *Andropogon* sp.: Emmasdale, Heidelberg, Union of South Africa, coll. not known, January 15, 1910 (U. D. Agr. Myc. Herb. *713*). *Andropogon* sp.: Prospect Cape, Union of South Africa, coll. H. Flanagan, January 1, 1916 (U. D. Agr. Myc. Herb. *9423*).

27. SOROSPORIUM DENBIANENSE Baccarini, Ann. Bot. (Italy) **14**: 132. 1917.

Sori destroying the ovaries and stamens, dark, included in a yellowish sheath, 5–7 mm. long; spore balls irregular, globose-ellipsoidal, 27–40 to 35–50 $\mu$ diameter, composed of 10–18 spores; spores globose-angular to ellipsoidal, easily separated, 9.6–11.2 $\mu$, minutely spiny.

On *Andropogon arrhenobasis* (*Heteropogon arrhenobasis*): Abyssinia. *Andropogon papillipes:* Abyssinia.

28. SOROSPORIUM ANDROPOGONIS-ACICULATI Petch, Ann. Roy. Bot. Gard. Peradeniya (Ceylon) **5**: 227. 1912.

Sori destroying the inflorescence, long linear, 4–7 cm. long, at first hidden by the sheath, later at least the greater part protruding, covered with an evident brown false membrane which flakes away revealing a brown, granular spore mass and long shreds of tissue; spore balls dark brown, opaque, permanent, globose-oblong, containing many spores, ranging from 28–76 $\mu$ diameter but usually 40–75 $\mu$; spores globose-subglobose, sometimes irregular, very light brown, smooth, 4–6 $\mu$ diameter.

On *Andropogon aciculatus* (*Chrysopogon aciculatus*): Ceylon; Japan; Philippine Islands.

## TOLYPOSPORELLA Atk. Bull. Cornell Univ. **3**[1]: 16. 1897

Spores less than 19 $\mu$ in diameter.
  Spores regular; episporè with concentric ring-like markings. *T. Brunkii*
  Spores irregular; smooth epispore..... *T. irregularis*
Spores 20 $\mu$ or more in diameter.
  Spores regular, 13–29 $\mu$, smooth..... *T. obesa*

1. TOLYPOSPORELLA BRUNKII (Ellis & Gall.) Clinton, Jour. Myc. **8**: 147. 1902.

*Ustilago Brunkii* Ellis & Gall. Jour. Myc. **6**: 31. 14 My. 1890.

Sori on the under side of the leaf sheath as striae which fuse forming a thick coating of granular spores; sori frequently

showing through on the upper side of the leaf sheath; spore balls not definite; spores more or less agglutinated; spores smooth with a central faintly granular endospore and an epispore with concentric ring-like markings; spores ranging from light reddish brown when young to dark reddish brown for the older spores, chiefly 9–19 $\mu$ diameter; epispore chiefly 2–4 $\mu$ thick.

On *Andropogon argenteus:* United States (Texas). *Andropogon hirtiflorus:* Mexico. *Andropogon saccharoides:* United States (Texas); Mexico.

2. **Tolyposporella irregularis** (Pazsche) Zundel, n. comb.

*Tilletia? irregularis* Pazs. Hedwigia **34**: 101. 1895.

Sori on the under surface of the leaf sheath, sometimes showing through and occasionally breaking through on the upper surface, forming short striae which frequently merge forming a mass of black granular spores; spore balls irregular in size, 25–175 $\mu$, with loosely connected spores (more or less agglutinated); spores smooth, irregular in shape, varying from globose to subglobose, often more or less angular, olive brown, 9–16 $\mu$ diameter and with an epispore about 2 $\mu$ thick; spore color varying with age, immature spores light olive brown, mature spores dark olive brown.

On *Andropogon* sp.: Brazil.

3. **Tolyposporella obesa** (H. & P. Sydow) Clinton & Zundel, n. comb.

*Entyloma obesum* H. & P. Sydow, Ann. Myc. **9**: 145. 1911.

Sori occurring on the leaves, tar-spot-like, up to 4 mm. diameter, raised; spores en masse dark reddish brown, singly, light reddish brown to light olive or occasionally nearly hyaline, subglobose-ellipsoidal, very irregular and angular by compression, with an endospore surrounded by a swollen epispore with rather distinct concentric striations; spores 13–29 $\mu$ diameter; endospore 5–10 $\mu$ diameter; spore balls very indefinite but spores adhere rather firmly; contents of endospore granular; spores smooth.

On *Andropogon annulatus:* India.

The structure of the spores and the superficial position of the sori on the surface of the host plant exclude this fungus from the genus *Entyloma*. It cannot be placed in *Sirentyloma* due to the lack of long chains of spores extending into the host tissues.

*Note.* After this article had gone to press the description of the following new smut came to the attention of the author.

*Ustilago Taiana* H. Sydow, Ann. Myc. **27**: 421. 1929. On *Andropogon micranthus* Kunth., prov. Kiangsu, Nanking, China. Leg. Dr. F. L. Tai (no. 2190).

PENNSYLVANIA STATE COLLEGE,
STATE COLLEGE, PA.

## NOTES AND BRIEF ARTICLES

It may be of interest to students of the Peronosporaceae to know that *Peronospora Valerianellae* Fuckel was found on *Valerianella radiata* in two localities in northwestern Arkansas in April, 1929. There appears to be no record of the occurrence of this mildew in North America but it does not seem probable that it is confined to the Ozarks.—J. J. DAVIS.

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Dr. G. W. Martin of the University of Iowa spent the month of March at The New York Botanical Garden working over the slime-mould collection. Dr. Martin is collaborating with Professor T. H. Macbride on a revision of his slime-mould book and is planning later to monograph the group for North American Flora.

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Dr. Mary J. S. Whetstone, Corresponding Secretary of the Minnesota Mycological Society, died of pneumonia at her home in Minneapolis, October 24, 1929, at the age of 80 years. As Mary J. Snoddy, she received the degree of M.D. from the University of Michigan in 1881. She was a practicing physician but had been interested for many years in the study of fungi. Her husband, Allen S. Whetstone, who was also a physician (Univ. of Mich., M.D. 1880), died at Minneapolis more than twenty years ago (April 19, 1909).

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### THE PENICILLIA

This voluminous work by Dr. Charles Thom, Principal Mycologist, Bureau of Chemistry and Soils, U. S. Department of Agriculture, assisted by Margaret B. Church, O. E. May, and M. A. Raines, has just been issued. The genus *Penicillium*, so called by scientists because of the resemblance of the fruiting bodies to miniature brushes but better known to the layman in general and especially to the house-wife as blue-green mould, is one of the most common and widely distributed genera of the fungi. It is, at the same time, one of the most difficult groups

to deal with because of the numerous species which have been described and in many cases very poorly characterized. Dr. Thom has undertaken in this work to bring together and summarize our knowledge of the known species.

After characterizing the genus in the introductory chapters considerable space is devoted to the "Distribution and Significance in Nature and Industry" of the various species of the genus. No group of fungi is of more interest from an economic point of view. In the rotting of bulbs; in the destruction of stored foods; in the decay of fibers; and in the deterioration of leather, meat, nuts, sugar, tobacco, etc., they are one of the most active agents and are truly the weeds of the fungus world. The annual loss from their attacks is difficult to estimate.

Not even man himself is free from the attacks of these lowly organisms. They are found associated with and may be the cause of diseases of the ear, eye, nails, skin, and even the lungs and other vital organs. They are also associated with diseases of other higher animals. After a thorough discussion of the general characters and economic importance of *Penicillia* the major portion of the book is devoted to a detailed treatment of the recognized species. The volume consists of i–vii + 1–644 pages and contains 99 illustrations. Published by The Williams & Wilkins Company, Baltimore, Maryland. Price $10.00.

FRED J. SEAVER

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## FUNGI DAKOTENSES

Dr. J. F. Brenckle's "Fungi Dakotenses," Fascicle 27, was issued October, 1929, and contains the following species: 651. *Aecidium Anograe;* 652. *Bullaria tumidipes;* 653. **Camarosporium umbonatum** n. sp.; 654. *Teichospora umbonata;* 655. *Cercospora dubia;* 655*a*. *Cercospora dubia;* 656. *Coleosporium Solidaginis;* 657. *Cytospora Amorphae;* 658. *Dicaeoma Asterum* I. 2*a*. *Dicaeoma Fraxini* I.; 659. *Dicaeoma Jamesianum* I.; 660. *Dicaeoma Rhamni* I.; 661. *Entyloma compositarum* [should be *E. polysporum*]; 478*a*. *Eutypella cerviculata;* 662. *Fenestella princeps;* 663. **Labridella Cornu-cervi** n. sp. & n. gen.; 664. *Lachnum sulphureum;* 665. *Patellaria atrata;* 666. *Parodiella grammodes;* 667. *Phialea sordida;* 668. *Phragmidium americanum;* 669. *Pleospora pygmaea;*

670. *Sordaria amphisphaerioides;* 671. *Sphacelotheca Ishaemi;* 672. *Stagonospora Meliloti;* 673. *Urocystis occulta;* 674. *Ustilago Avena;* 675. *Ustilago hypodytes;* 90*a*. *Ustilago levis*. On the back of table of contents of this fascicle the following new species and genera are described: **Labridella** n. gen. Leptostromataceae. Pycnidia dark, linear to lanceolate, separate or several aggregate, rimose-gaping, ramicole: Conidia unequally septate, dark, with a branched hyaline appendix and a rod-like basidium. **Labridella Cornu-cervi** n. sp. Pycnidia black, linear when young, lanceolate and rimose-gaping as spores develop, .5 to 2 mm. long by .2 to .5 mm. wide. Pycnidial membrane black, granular, two-layered: an outer composed of dark, septate, branched hyphae, closely packed; an inner hyaline-yellow with indistinct cells. Dehiscent by cracking and spreading of the dome, the edges of the membrane falling away and finally widely open. Conidia dark brown, lanceolate, straight or slightly curved, sharply narrowed at the base to a hyaline basidium, tapering at the upper end to a long branched, hyaline appendix with two to five branches springing from one side, mostly near the base, often curved and spread much like a deer-horn. Mature conidia are unequally four-septate, the proximal cell is cone-shaped and joins with the basidium, the second cell is much the largest and usually retains its nucleus, the three remaining cells are about equal in length, but narrowed somewhat toward the end. The basidium is about 8 to 12 by 2 mic. in size. The body is about 30 to 35 by 8 to 11 mic. and the appendix about as long, and 3 to 4 mic. wide at the base. On bleached wood or erumpent through falling bark of *Symphoricarpos occidentalis*. **Camarosporium umbonatum** n. sp. Perithecia separate, scattered or aggregated about the nodes and small twigs, erumpent but soon superficial by falling of the bark, conical to hemispherical, chestnut-brown to black, smooth and shiny, .2 to .4 mm. wide. Conidia lanceolate, brown, 3-septate, one of the mid cells longitudinally divided, 14 to 17 by 6 to 7 mic. in size. Probably related to *Teichospora umbonata* E. & E. On dead twigs and stems of *Symphoricarpos occidentalis*.

NORTHVILLE, S. D.

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